# SOIL SURVEY OF WASHINGTON COUNTY, OREGON.

By E. B. WATSON, In Charge, and E. C. ECKMANN, of the U. S. Department of Agriculture, and A. L. FLUHARTY and C. V. RUZEK, of the Oregon Agricultural Experiment Station.—Area Inspected by MACY H. LAPHAM.

## DESCRIPTION OF THE AREA.

Washington County is located in the northwestern part of Oregon. It includes the valley of the Tualatin River, a part of the large basin known as the Willamette Valley, lying between the Coast Range and the Cascade Mountains.

The business center of Portland is 3 miles east of the extreme eastern boundary line of the county, and the Pacific Ocean is 23 miles west of its most western part. The county is irregular in outline. It covers an area of 731 square miles, or 467,840 acres.

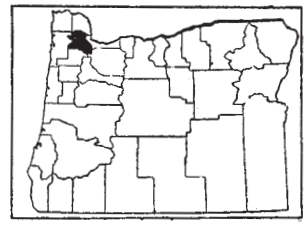

FIG. 42.—Sketch map showing location of the Washington County area, Oregon.

The base map used in plotting the soils consists of the topographic sheets published by the U. S. Geological Survey, which cover the eastern third of the county, and of a map constructed by plane-table traverse by the soil survey, covering the rest of the county.

The county occupies a large central lowland area or valley almost completely surrounded by rolling hills or low mountains. This valley, known as the Tualatin Valley, lies in the central and southeastern part of the county and covers about one-fourth of its area. It is about 10 miles wide and 15 miles long with its longer axis extending in a northwest-southeast direction. Near its southeastern end are two large hills, Cooper Mountain and Bull Mountain, which partly constrict the valley, but narrow extensions continue past these hills on both sides for 8 or 10 miles to the southeastern corner of the county. The elevation of the valley is from 140 to about 275 feet above sea level. It is a broad plain sloping gently from the surrounding hills to the Tualatin River, which drains it and passes out of the county near the southeastern corner. The flood plains of this stream and its main tributaries lie from 5 to 20 feet below the general level of the main valley.

The Tualatin Valley, evidently a structural valley, lies between two low ranges, spurs of the main Coast Range. On the northeast-

ern side is the long narrow spur of the Coast Range which borders the Columbia River upon the south and reaches to Portland. It has an elevation of 800 to 1,400 feet. South of the valley is the other spur, the Chehalem Mountains, with about the same elevation. West of the valley is the main Coast Range, with elevations ranging from 1,000 to 2,000 feet over most of it, but with a few peaks that are from 2,000 to 2,600 feet high.

Cooper Mountain and Bull Mountain have elevations of 794 feet and 711 feet, respectively. They are very similar in character to the lower hills and slopes of the adjacent mountains, which rise to elevations not exceeding 1,000 feet. The slopes are smooth and rounded; some are moderately steep, but the lower ones are gentle. The steeper slopes are usually adjacent to the small streams. The crests of the hills have gentle slopes or are rounded. On the lower hills probably half the surface is easy to cultivate, and very little of it is entirely nonagricultural. The slopes and hills which are more than 1,000 feet in elevation are usually steeper, and a smaller proportion of the land is tillable. Some of these hills are stony or rocky, but usually the rocks of the hills and mountains included in this survey are very deeply weathered and covered by a deep mantle of soil.

The original dense forest covers much of the hilly and mountainous parts and is broken only by clearings or burns. At the time the county was first settled there were large prairies in the main valley, probably half or more of the valley being treeless. Since settlement much of the forested valley land has been cleared, but in places the forest has been allowed to encroach on the farm land, and it is reported that there are considerable areas now covered with oak and fir that formerly were cultivated.

In the hills surface drainage is thoroughly developed, the streams branching and subdividing until they reach all parts of the hilly country. The smaller streams in the higher hilly areas flow in V-shaped valleys and have swift currents. The valleys of the larger streams are rather broad, showing considerable age, and the largest streams have developed considerable flood-plain areas.

Through the main valley the streams flow with a very moderate fall. Tualatin River takes care of the dainage for most all of the county. It rises in the southwestern part of the county, passes out of the county near the southeastern corner, and joins the Willamette River a few miles farther east. Dairy Creek and Gales Creek are the main tributaries from the north. There are no large streams from the south side, as the river flows very close to the southern edge of the valley. The natural surface drainage for most of the main

valley has been well established, but there are a few flats and basins to which the drainage system has not extended in its normal development. Lake Wapato, on the southern boundary of the county, and Lousignont Lake, northwest of Forest Grove, both of which have been filled with Peat, are two such areas. The southwestern corner of the county is drained by the Trask River, and the northwestern corner by the Nehalem and Salmonberry Rivers, all of which flow west into the Pacific Ocean.

The first permanent settler came to what is now Washington County in 1834. During the next seven years 12 or 15 families came into the county. In 1842 to 1844, there was a large influx of settlers, who came from all parts of the United States, but mainly from the Mississippi Valley. Later there were other immigrants from the same source. The population has remained dominantly American-born. According to the 1910 census, 29 per cent are foreign born; about half of these are German and the rest are Swiss, Scandinavian, Canadian, Austrian, English, and Irish.

Washington County was organized in 1849. In 1850 it had a population of 2,652. The census of 1920 gives it a population of 26,376. Hillsboro, the county seat, was founded in 1843 and has now a population of 2,468. Forest Grove, 7 miles west of Hillsboro, is the seat of Pacific University and has a population of 1,915. Banks, Beaverton, Cornelius, Gaston, Orenco, Sherwood, Tigard, and Tualatin are small towns in various parts of the valley, each with a population of less than 600. There are no cities of over 2,500 population, and therefore the population is all classed as rural. The census of 1920 gives a density of 36.1 persons per square mile. As only about half of the county is in farms, this means about 70 persons per square mile for the settled parts of the county. The land in the valley is entirely taken up, and the farms are of moderate size. In the lower foothills the population is more scattering, while in the more remote and higher parts of the hills there is no settlement.

The Southern Pacific Railroad Co. operates two electric and freight lines from Portland which pass through the main agricultural part of the county, and a steam line which branches off from the electric line at Hillsboro and runs north and west into the forested country in the hills, and thence to the coast. The Oregon Electric Railroad also operates a line from Portland to Eugene, passing through the eastern part of the county, and a branch line from this runs west through Hillsboro to Forest Grove. The United Railways operates a line from Portland through North Plains to Wilkesboro. From this point the Gales Creek & Wilson River Railroad, which is planned to reach the coast, is being built up Gales Creek. The Willamette Valley & Coast Railroad connects Cherry Grove with Patton.

The county is well supplied with wagon roads, which are maintained in fair to good condition. Many of the main roads in the level part of the valley are graveled. Some of those in the hills, especially where lumbering is carried on, are covered with plank or "corduroy." The roads that have not been surfaced get very dusty and rough in summer and very muddy in winter. The main line of the West Side Highway, a surfaced road, runs across the southeastern part of the county, passing through Tigard.

Telephone service in the county is ample. Churches of all denominations are numerous. There is a good public school system. Pacific University is located at Forest Grove, and several denominational schools elsewhere in the county.

Portland is the main outside market for the agricultural products of the county. A large proportion of the milk is sold to the two condenseries located at Hillsboro and Forest Grove. A part of the fruit and vegetables is sold to local canneries, of which there are several.

## CLIMATE.

Washington County has a mild, humid climate, with a mean annual temperature at Forest Grove of 51.1° F. There are two principal seasons, a wet and a dry season. The wet season extends from about the middle of October to the first part of May, during which period about 97 per cent of the annual precipitation occurs. July and August are usually very dry, with a normal total rainfall of less than an inch for both months. Between the middle of June and the first part of September, a period of about 75 days, very little rain may normally be expected. The distribution of the rainfall is decidedly favorable to the growing of winter grains, while the freedom from rains in the summer gives an ideal condition for haying and harvesting. The annual rainfall, according to Weather Bureau records at Forest Grove, during a period of 23 years, has varied from 35.22 inches in 1892, the driest year, to 65.88 inches in 1904, the wettest year. The average annual precipitation is 48.74 inches. This amount is ample for crop production if properly conserved, though in unusually dry summers the yields of berries, vegetables, and spring-grown grains are frequently reduced by drought. Hard rainstorms are exceptional, the heavy precipitation during the winter coming as gentle rains, with much cloudy and foggy weather. The snowfall varies considerably; sometimes there is very little in the valley and at other times a foot, but snow usually does not remain upon the ground more than a week. There is more snow in the hills, and it stays a longer time. Because of the lack of snow protection, clover and fall-grown grain crops are injured more or less by freezing.

The highest temperature recorded at Forest Grove is 103° F. and the lowest is —11° F. The average date of the last killing frost in the spring is May 14, and that of the first in the fall is October 6. The latest recorded date of killing frost in the spring is May 24, and of the earliest in the fall September 11. The average growing season is 145 days.

The table below, giving the normal monthly, seasonal, and annual temperature and precipitation for a period of 23 years, was compiled from records of the Weather Bureau station at Forest Grove, near the center of the county, and is representative of the valley part of the area. The hilly part of the county, lying west and north of the valley, owing to its elevation and its nearness to the ocean, has a slightly different climate. It is somewhat cooler in the summer and has more rainfall in the winter.

*Normal monthly, seasonal, and annual temperature and precipitation at Forest Grove.*

(Elevation, 220 feet.)

| Month. | Temperature. | | | Precipitation. | | | |
|---|---|---|---|---|---|---|---|
| | Mean. | Absolute maximum. | Absolute minimum. | Mean. | Total amount for the driest year (1892). | Total amount for the wettest year (1904). | Snow, average depth. |
| | °F. | °F. | °F. | *Inches.* | *Inches.* | *Inches.* | *Inches.* |
| December | 39.4 | 64 | 9 | 8.12 | 4.67 | 13.49 | 1.9 |
| January | 37.1 | 60 | —11 | 7.97 | 4.69 | 7.89 | 10.2 |
| February | 40.4 | 77 | — 1 | 6.54 | 1.52 | 14.91 | 4.4 |
| Winter | 39.0 | 77 | —11 | 22.63 | 10.88 | 36.29 | 16.5 |
| March | 44.5 | 79 | 16 | 4.55 | 2.77 | 11.62 | 0.8 |
| April | 49.3 | 93 | 21 | 2.88 | 4.96 | 2.78 | T. |
| May | 55.4 | 98 | 28 | 2.17 | 1.90 | 0.20 | 0 |
| Spring | 49.7 | 98 | 16 | 9.60 | 9.63 | 14.60 | 0.8 |
| June | 60.0 | 98 | 34 | 1.45 | 0.78 | 0.02 | 0 |
| July | 65.3 | 103 | 35 | 0.52 | 0.69 | 0.53 | 0 |
| August | 66.1 | 100 | 35 | 0.42 | 0.28 | T. | 0 |
| Summer | 63.8 | 103 | 34 | 2.39 | 1.75 | 0.55 | 0 |
| September | 59.3 | 94 | 27 | 1.76 | 2.62 | 0.50 | 0 |
| October | 51.8 | 87 | 23 | 3.37 | 2.97 | 2.61 | 0 |
| November | 44.3 | 77 | 7 | 8.99 | 7.37 | 11.33 | 0.5 |
| Fall | 51.8 | 94 | 7 | 14.12 | 12.96 | 14.44 | 0.5 |
| Year | 51.1 | 103 | —11 | 48.74 | 35.22 | 65.88 | 17.8 |

## AGRICULTURE.

Washington County has been primarily an agricultural county since its earliest settlement. Agriculture began in 1834[1] with the taking up of land on the upper benches of the Tualatin River and its tributaries. These benches were known as plains, although they supported frequent groves of fir and oak. They had a good covering of native grasses and a system of general farming was practiced, with the raising of live stock as the chief source of income. The growing of field crops, vegetables, and fruits was confined chiefly to small acreages to supply home needs. By 1850 probably most of the prairie land in the county and a small part of the timberland could be classed as farm land. Bancroft, in his history of Oregon, says that in 1848 most of the people in Oregon were stock raisers and grain growers, and that the extent of the land cultivated was not great, only from 20 to 50 acres being in cereals on any one farm. This unquestionably applies to Washington County.

With the increase in the number of settlers, the range for cattle was pushed farther back into the hills, and the acreage in field crops was gradually increased. Wheat and oats began to assume the importance which they have subsequently held. Later dairying and the growing of fruits and some other special crops developed.

According to the census of 1920 Washington County is fourth among the counties of the State in value of agricultural products. The total value is stated at $10,617,556. The distribution of this sum among the various classes of products is shown in the following table:

*Value of farm products in 1919.*

| Products by classes. | Value. | Products by classes. | Value. |
|---|---|---|---|
| Cereals | $2,662,526 | Poultry and eggs | $690,961 |
| Other grains and seeds | 195,607 | Dairy products (excluding home use). | 1,902,073 |
| Hay and forage | 2,061,330 | Animals sold and slaughtered [1] | 674,000 |
| Vegetables | 1,302,772 | Total live-stock products | 3,267,034 |
| Fruit and nuts | 996,754 | Grand total | 10,617,556 |
| All other crops | 131,533 | | |
| Total of all crops | 7,350,522 | | |

[1] This item is not reported in the 1920 census. These figures are only approximate, and are based on the assumption that the value of animals sold and slaughtered had the same relation to the total value of all domestic animals in 1919 as in 1909.

In point of value the cereals hold first place, and of these crops wheat and oats are most important, occupying in 1919 a combined acreage of 51,109 acres out of a cereal acreage of 53,441.

[1] A drove of 600 cattle brought from California to Oregon in 1837 marked the real beginning of agricultural development in the county, as well as in the rest of the Willamette Valley.

Referring to wheat growing in the Willamette Valley in the early days, a department publication[2] states: "From the most reliable information available it appears that wheat in those early days yielded from 30 to 40 bushels per acre and oats from 50 to 75 bushels. For a number of years the land produced a crop each year. However, the soil soon became infested with wild oats, and about 1865 the farmers began to summer fallow; that is, the land was clean cultivated once in every three or four years. Under this system of farming crop yields gradually declined. The average yield of wheat in the eighties was probably not far from 17 bushels per acre."

Nevertheless the growing of wheat in Washington County, judging by the acreage, increased from 1880 to 1900, when the crop occupied an area of 25,530 acres. From that year until 1917 it declined to 7,518 acres,[3] the abandoned acreage being taken in large part by oats and hay and forage crops.[4] This abandonment of wheat growing would seem to indicate the normal tendency of change in the agriculture of the county, but under the unusual stimulus of war demands for the bread grains the wheat acreage rose suddenly to 29,161[5] acres in 1918 and remained at 24,905 acres in 1919, the area returned in this crop by the United States census. The main causes of the decline in wheat growing prior to 1918 are probably two—a somewhat inferior milling quality and the marked development of the dairy industry with the necessary increase in the acreage of crops upon which it must depend. In the earliest days spring wheat was grown almost exclusively; to-day the winter varieties are grown. They are of soft milling quality.

The following table gives the acreage, production, and yield per acre of wheat and oats in Washington County for the last five census years:

*Acreage, production, and yield per acre of wheat and oats, 1879 to 1919.*

| Year. | Wheat. | | | Oats. | | |
|---|---|---|---|---|---|---|
| | Area. | Yield. | Average yield per acre. | Area. | Yield. | Average yield per acre. |
| | *Acres.* | *Bushels.* | *Bushels.* | *Acres.* | *Bushels.* | *Bushels.* |
| 1879 | 20,581 | 370,770 | 18 | 9,328 | 309,230 | 33 |
| 1889 | 21,429 | 494,908 | 23 | 16,203 | 538,783 | 33 |
| 1899 | 25,530 | 523,320 | 20.5 | 21,059 | 651,750 | 30 |
| 1909 | 9,543 | 239,918 | 25 | 29,358 | 1,152,816 | 39 |
| 1919 | 24,905 | 700,085 | 28 | 26,204 | 1,124,452 | 43 |

[2] Farmers' Bulletin 705, Profitable Management of General Farms in the Willamette Valley, Oregon.

[3] Figures from reports of threshers to the State.

[4] Wheat grown for hay doubtless a very considerable item.

[5] Ibid.

It will be noted in the foregoing table that the acreage in oats is greater than that in any other cereal. It is also greater than that in any other field crop, though exceeded by the group hay and forage crops. Oats are a cash crop. Part of the crop is cut for hay, but the greater part is threshed. Fall-sown oats yield best and are used in preference to the spring varieties where there is no danger of winter-killing because of poor drainage.

The hay and forage crops are particularly important as the basis of the dairying industry. The combined acreage in these crops in 1919 amounted to 37,924 acres. Of this, 20,102 acres were in tame grasses, including clover and timothy mixed, 5,358 acres; clover alone, 8,607 acres. Of the coarser crops in this group the largest acreages were in small grains for hay, 9,104; silage crops, 3,753 acres; annual legumes, 2,182 acres.

Clover and vetch were introduced during the eighties and early nineties and have gradually increased in acreage. They served an evident need for putting the agriculture of the county on a sound basis. They aided in the development of the live-stock industry, played an important rôle in keeping up the fertility of the soil, and have made the practice of summer fallowing obsolete.

Clover now plays an important part in the agriculture of the county in conjunction with the dairy industry. Red clover is grown on the better drained soils and alsike generally on the poorer drained soils. Clover has done much to keep up the fertility of the soils and to restore it to those soils that had been depleted by the continual growing of small-grain crops. It is generally sown in the spring on fall-sown grain and produces both a hay and a seed crop the following year. Grass seed is often sown with it, in which case it is used for pasture the second year.

Vetch, an annual legume, commonly spoken of as tare, now occupies a prominent place among the forage crops. It is either seeded alone for hay or in combination with a small-grain crop, such as wheat or oats. Excellent yields of seed are obtained also, and when grown for seed it is a very profitable sale crop. It can be used to advantage as a green-manure crop, and is used chiefly in orchards for this purpose.

Between 1880 and 1890 the production of potatoes, onions, and other truck crops adapted to the Muck and Peat and sandy soils became of importance, the produce finding a ready market in Portland. The census of 1900 gives the acreage of potatoes as 2,979 acres and of onions 468 acres. According to the last census the former crop occupied an area 4,536 acres, and other vegetables, mainly onions, 630 acres. Washington County is among the leading counties of the State in the production of onions.

Potatoes are grown on practically every farm in the county to supply the home needs, only the surplus being marketed. In certain sections potatoes are the chief cash crop. They are marketed outside of the county, a large proportion of the crop going to Portland. A potato-starch factory located at Beaverton contracts with the growers to take all the cull potatoes, thus enabling farmers to market nothing but the better grades for food.

Hops have been an important crop in the county. The first crop was grown about 1880, and production on a large scale began between 1890 and 1900. In 1909 there were 1,675 acres in hops in the county, and the acreage continued to increase for a few years thereafter, but during the last five years production has decreased very rapidly because of an unsatisfactory market, and very few hop yards are left, their combined acreage, as reported by the 1920 census, being 392 acres. Hops have been grown largely on the Willamette loam, the Chehalis silt loam, the Aiken silty clay loam, and the Melbourne loam. They are not confined to the recent alluvial soils in this county as they are in the great hop-growing sections of California.

During the decade 1880 to 1890 some commercial orchards of prunes, apples, and pears, which had done well in the home orchards, were set out, but these fruits were not grown extensively for another decade. According to the census of 1900 apples ranked first in orchard fruits, with 156,565 trees, and prunes second, with 107,495, the respective productions in 1889 being 38,300 and 10,287 bushels.

By 1910 many new orchards had come into bearing, and prunes became the leading fruit crop, with a production in 1909 of 110,553 bushels. Apples occupied second place, with a production of 92,843 bushels.

Fruit now occupies a prominent place among the commercial crops of the county.

The census of 1920 gives the total number of trees of bearing age in the county as 295,303 and of trees not of bearing age 89,958. These totals are made up principally of prunes, with 150,723 trees of bearing age and 73,306 trees not of bearing age, and apples, 114,134 and 11,081 trees, respectively, of the two classes. The production of prunes in 1919 was 162,290 bushels and of apples 245,991 bushels.

Fruit growing is rather highly developed in the hill sections of the county and has largely taken the place of wheat in what were once the wheat-producing sections of the county. The success of the first plantings proved the marked adaptability of the "red hill land" to prunes, and large commercial plantings have been made on these soils with the result that this fruit is now one of the most important cash crops of the county. The large Italian prunes are grown

mostly. The small French variety also is grown to a small extent. The best soils for prunes are the loams and clay loams of the Aiken, Olympic, and Melbourne series. Exceptionally fine orchards are situated on the Olympic soils north and west of Forest Grove in what is locally known as the David Hill section. There also are some fine vineyards in this section. (See Pl. XLIII, figs. 1 and 2.)

Pears are grown commercially and do very well on any of the deeper hill soils. They are also grown in family orchards on all soils in the county.

Walnut growing is in its infancy in this county. The first commercial orchard was planted in 1905 and is now in profitable bearing. There are probably about 150 acres of walnut groves, besides other scattering trees planted around homes. The Franquette is the only variety planted. Walnuts demand a deep, well-drained soil. They have been found to do well on the deeper variations of the Aiken silty clay loam and the Melbourne loam.

Cherries are grown upon almost every farm in the county. The trees yield well, and when properly taken care of are quite profitable. The larger orchards are generally located on the hill lands of the county.

The important commercial orchards of apples also are on the hill lands, although most every farm has an orchard of 1 to 3 acres of mixed varieties. A large nursery is located at Orenco, where both soil and climate seem to be especially suited to this business. The nursery stock is shipped all over the State and to the adjoining States.

The dairy industry dates from about 1890. Creameries were established until there were more than a dozen in the county. But soon after 1900 the condenseries began operations, and as they could pay a higher price for butter fat they soon drove the creameries out of business. Two large condenseries were established in the county, one at Forest Grove and the other at Hillsboro. Later a cheese factory was established at Christie. These plants did much to make dairying the permanent and leading industry of the county. Pure-bred cattle were brought into the county, and there was a gradual building up of the dairy herds to increase their production of milk and butter fat. Because of the necessity for more feed, the wheat acreage was reduced, the production of oats and clover was increased, and more grain was cut green for feed.

The dairy industry now constitutes one of the most important sources of revenue. There are at the present time more than 14,000 dairy cows in the county. The cows are mostly of the Jersey and Holstein breeds; they are very good stock, many of them being pure bred. Almost no butter is made. The condenseries get practically all of the milk in the county, except that produced in the northeastern part, east of Beaverton, which is shipped to Portland.

The cows are not pastured to any great extent. Wheat and vetch or oats and vetch are cut green and fed. Silage made from corn is fed in winter. A great deal of mill feed is used. The number of silos is increasing rapidly. Dairying is practically confined to the valley soils.

A few hogs are kept on nearly every farm. Those not needed for home use are marketed. The total number in 1919 was 11,010.

In the same year there were 5,960 sheep in the county. Most of them are kept in the hills during the summer months, but after the harvest of wheat and other small-grain crops, are brought to the valley and given the run of the fields until the time for fall plowing. Flocks are often allowed to pasture the newly seeded clover throughout the summer. Some herds of goats also are pastured in the hilly sections of the county.

Poultry and eggs are produced on practically every farm in the county. A considerable number of the small farmers in the northeastern part of the county have gone into the poultry business on a large scale within recent years, but the high price of feed during the last years of the war and immediately thereafter had a discouraging effect on the industry. However, the business is still quite extensive, and the county ranks as one of the leading poultry producing counties in the State. According to the 1920 census the county stands third among the counties of the State in value of poultry products sold.

The rotation most commonly practiced throughout the county consists of small grain for one year, clover for either one or two years, and a cultivated crop for one year. The clover is seeded in the early spring on fall-sown grain, and harvested the second summer for hay and for seed. Often a grass mixture is sown with the clover, and it is allowed to remain another year for pasture. In some places, where it is difficult to get a stand, clover is sown alone in the early summer months. Vetch or oats, or vetch and oats combined, are often used in the rotation in place of a clover crop.

Very little commercial fertilizer is used in the county, and this is used mainly on truck crops. Many farmers use land plaster or gypsum on clover, alfalfa, and vetch at the rate of 100 to 200 pounds per acre, and they report good results.

Laborers employed on the farms are mostly American and are efficient. Until the year 1918 the supply was fairly abundant. During the harvest season additional help is obtained from Portland and vicinity. The monthly wage ranges from $50 to $60 per month and board. During the harvest season $3 per day is paid.

In the eastern half of the county the farms range in size from 10 acres to as high as several hundred acres. There are many small

farms in this section of the county. In the western or middle section of the agricultural part of the county the farms are larger, ranging from 50 to several hundred acres. The townships along the western line of the county are still in fir timber and undeveloped.

The proportion of rented farms is slightly greater than in 1910. According to the 1920 census 80.9 per cent of the farms are operated by owners, 1.3 per cent by managers, and 17.8 per cent by tenants.

The cost of clearing land is high at present, owing to the high cost of explosives and the scarcity of labor, but it is said that previous to the war stump land could be cleared for $100 an acre or less.

The price of farm land in this county is governed by topography, drainage, amount of clearing and improvements, distance from markets, and proximity to good roads and railroads, and in the northeastern part of the county by its suburban value. The actual soil characteristics, which are the basis for soil classification in this report, have only a slight bearing on the selling price of land. Land in the valley, improved for general farming, sells for $100 to $200 an acre, the average being about $125 an acre. Land of the Olympic and Melbourne soils in the hills, if fairly smooth, sells for $75 to $150 an acre. Cut-over hill land can be bought for $10 to $20 an acre, depending upon location and topography. Some can be bought even cheaper, but is of doubtful agricultural value. Land in bearing orchards varies very widely in price.

Muck and Peat land reclaimed for growing onions is worth $600 to $1,000 an acre.

## SOILS.[6]

The soils of Washington County have developed under the influence of a relatively high rainfall, all of it falling during the winter and very early spring months, a relatively warm winter, and moderately hot and dry summer. They are humid soils, the well-drained types being light in color, dark-colored soils being confined to those that were wet under natural conditions throughout the year. Although the smooth portions of the region were grasslands or very open park lands when it was first visited by the white man, no well-drained, dark-colored soils were developed. The combination of grass cover and high total rainfall in the middle western prairie States of the Union, however, produced a cover of black to

[6] All the types mapped in Washington County join with the same types in Yamhill County, with exception of the Melbourne loam, which joins with the Melbourne clay loam of Yamhill County, and the Wapato silty clay loam, which joins with the Wapato silty clay of Yamhill County. These types join only for short distances along the boundary. Their texture seems to grade somewhat lighter in the more northern area, and their boundaries, more or less arbitrary, are indistinct; probably a better line occurs at some indefinite point near the boundary between the two counties.

very dark brown soils. The absence of such soils in the Willamette Valley may be due to a change in the native vegetative cover from timber to grass a very short time preceding the advent of the white man or it may be considered as the usual product of the existing combination of vegetation and climate—the warm, dry summers being responsible for the lack of an accumulation of organic matter derived from grass roots. Some of the evidence so far accumulated in this country would indicate that the second of the two explanations presented is the true one. In the southern part of the United States, where the summers are hot and dry, the surface soils, in belts of soils which, in the northern part of the country are black in color, are dark brown or chocolate brown even where the darkest, and in places of rolling topography and rapid surface drainage the color may be red rather than black. On the other hand, the black soils of the Palouse region of Washington have developed in a region with a winter rainfall and a summer dry period. The total rainfall, however, of the Palouse region is much less than is that of the Willamette Valley. It would seem, therefore, that while a dry summer climate may prevent the accumulation of organic matter in the soil of a treeless, humid region, it is not able to prevent such accumulation in a region of low rainfall, where the soil contains carbonates.

Outside the valley floor and the lower foothills the region was heavily forested. The forest extended also over considerable areas of the valley floor, for there can be relatively little doubt that the whole well-drained part of the valley floor is potential forest land. The rainfall of the valley floor is but little less than 50 inches, and that of the hills is higher, especially along the western side of the valley. The forest growth is dense and the soil is shaded throughout the year. Although the soil in virgin condition is normally covered with an accumulation of forest débris, often several inches thick, yet there is no surface growth of mosses. The soil does not present the evidences of the leaching from the surface horizon of its iron and alumina nor of the accumulation in the subsurface of an excess of iron oxide, alumina, and organic matter, which normally takes place under the operation of the weathering process known in soil literature as podsolization. The soil profile is essentially like that in the timbered region of northern Ohio, Indiana, southern Michigan, and southern Wisconsin.

The soils are brown soils rather than gray, although the total rainfall is higher than in northern Wisconsin, northern Minnesota, and northern Michigan, where typical gray soils are widespread. It seems probable that the warm, dry summers are entirely responsible for this development of brown soils in a latitude and under a total rainfall unfavorable to their development. The surface soils

are not kept moist during the summer and the vegetable débris does not develop into the dry, peaty material known in German soil literature as "trockentorf," but assumes a form more nearly like that found in the more open forests of Ohio and Indiana.

The detailed differentiation of the soils of the county is based on conditions explained below.

Washington County is in the Pacific Coast soils region. The soils may be grouped broadly in two divisions, on the basis of the processes by which the soil material was accumulated. These are: (1) Soils derived from consolidated rocks through weathering, and (2) soils derived from material accumulated by deposition from water.

The soils from residual material fall into two groups, those derived from igneous rocks and those derived from sedimentary rocks. The igneous rocks in this county have all a basic character of low quartz content. Most of them consist of a hard, fine-grained basalt, but there are minor exposures of other basic rocks that are coarser grained. These rocks are remnants of old lava fans and volcanic intrusions and dikes within the sedimentary rocks. Some of the intrusions are several miles wide; some have a width of only a few rods. From these rocks are derived the red Aiken soils and the brown Olympic and Cascade soils, which are usually found on the higher hills. The sedimentary rocks, which in this area probably are of Tertiary age,[7] consist of shales and sandstones of various textures, usually gray or grayish brown in color. They are generally found on the lower hills, but also occur in the higher part of the Coast Range. They are broken by frequent intrusions of igneous rock. On weathering they give rise to the brown Melbourne soils and the grayish-brown Carlton soils.

Owing to the thorough weathering which most of the rocks of the area have undergone, rock exposures are not numerous. Moreover, the structural characteristics of the more or less weathered rocks of different kinds are more or less alike. Over much of the county, therefore, it is difficult to identify, from the characteristics of the soils and the more or less completely weathered materials, the rock formations from which they are derived. Consequently, the classification of the soils upon the basis of mineralogical origin is sometimes difficult, and soils that are derived from one class of rocks may include areas of soils similar in color and character but derived from the other class of rocks.

It was particularly difficult to establish boundary lines between the types of the Olympic and Cascade series, on the one hand, and those of the Melbourne series, upon the other, as occurring in this county. The true character of the parent rock in some of these

[7] Reconnaissance of the Geology of Oil Prospects of Northwestern Oregon, by Chester W. Washburne, U. S. Geological Survey, Bul. 590.

areas was correctly determined only by petrographic examination of samples after the field mapping had been done. Consequently the classification of the soils on the basis of geological origin must not be too rigidly interpreted, as in doubtful cases the soils were correlated in accordance with characteristics of color and soil profile rather than inferred or doubtful relationship to the parent rock. Chemical analyses made by the Bureau of Soils covering soils derived from basaltic rocks as well as those derived from sedimentary material show relatively little differences in composition between the soils of the two groups. The heavy rainfall and relatively high temperature prevailing in the region have operated to such an extent that the mature well-drained soils of the county, and in fact, of the region, have been brought to a relatively uniform chemical composition regardless of the rock from which the material has been derived. The soils are less thoroughly leached than the sandy soils of the humid region of the southeastern States and more thoroughly leached than the soils of the Great Plains region. The difference between the soils of the various kinds of rocks in the county are more often merely those of topography than of any pronounced difference in composition, chemical or physical.

Soils derived from water-deposited material may be grouped into (1) old valley filling soils and (2) recent alluvial soils. The soils of the first group are derived from modification and weathering of the older alluvial deposits of the valley. Their age is indicated by the comparatively low content of soluble minerals and by the transportation of the finer soil particles from the surface to the subsoil, producing usually a subsoil heavier or more compact than the soil. The old valley filling soils are of mixed origin, the materials having been transported from soils derived from the various rocks of the region. They lie on the floor and gentle slopes of the valley, but usually well above the flood plains of the present streams. These soils are classed in four series, the Willamette, Hillsboro, Amity, and Dayton.

The soils of the second group, those consisting of recent alluvial deposits, were deposited by streams and have not undergone sufficient weathering or other modification in place to change their essential character. They are of mixed origin, the materials having been carried by the streams from soils derived from sandstones, shales, and igneous rocks. They line on the flood plains of the streams. Differences in color of the surface soils and in the character of the underlying material warrant the mapping of four soil series, the Chehalis, Camas, Wapato, and Whiteson.

In addition to the soils in the three main divisions, small areas of Muck and Peat, and extensive areas of Rough mountainous land have been mapped. The latter includes materials representing a number

of soil series and types, the areas of which are rough and unsuited for agriculture.

Most of the soils appear to be deficient in lime, and the more weathering they have been subjected to the more acid they have apparently become.

The following table or key shows the relationship of the different soil series in Washington County:

*Origin and color characteristics of the several soil series developed in Washington County.*

| Group. | Origin. | Characteristics. | Series. |
|---|---|---|---|
| Residual soils | Basic igneous rocks | Red soils | Aiken. |
| | | Brown soils | Olympic. |
| | | Brown soils, yellow subsoils | Cascade. |
| | Sedimentary rocks | Brown soils | Melbourne. |
| | | Gray-brown soils | Carlton. |
| Old valley-filling soils | Mixed rocks | Brown soils, brown heavier subsoil | Willamette. |
| | | Brown soils, lighter textured subsoil | Hillsboro |
| | | Gray-brown soils, mottled subsoil | Amity. |
| | | Gray soils, compact heavy mottled subsoil | Dayton. |
| Recent alluvial soils | Mixed rocks | Brown soils, brown subsoil | Chehalis. |
| | | Brown soils, gravel subsoil | Camas. |
| | | Dark-brown soils, mottled subsoil | Wapato. |
| | | Gray soils, dark-gray heavy mottled subsoil | Whiteson. |

Soils are grouped into series mainly on the basis of color, origin, structure and topography. The series are divided into types, the unit of soil mapping, on the basis of texture. A description of the series follows.

The surface soils of the Aiken series are red to deep red or dull red in color, with pronounced reddish-brown variations. The subsoil has a similar or somewhat lighter red color and is characteristically more compact and slightly heavier in texture than the surface soil. The underlying rocks, from which the series is derived, are deeply weathered, rarely occurring within the 3-foot section, but outcrops occur in places. The surface soil and subsoil are noncalcareous. A characteristic feature is the presence of small iron-cemented pellets. The topography is smooth and sloping to rolling or hilly and steep, and in places rough and stony. Surface drainage is generally excessive. The series is residual in origin and typically derived from igneous and metamorphosed igneous rocks of basic character. As occurring in this county they are derived mainly from basalt. In places they merge with types of the Olympic series. The native vegetation consists mainly of fir, with some cedar, oak, and under-

brush. Two types, the silty clay loam and the clay loam, were mapped in Washington County.

The surface soils of the Olympic series are brown or rusty brown to rather dark brown. The subsoil is usually reddish brown or lighter brown and typically somewhat heavier in texture or more compact in structure than the soil. Both surface soil and subsoil are well leached and free from lime carbonate. Iron concretions are conspicuous, particularly in the surface material. Bedrock rarely occurs within the 3-foot profile. The topography is rolling to steep and hilly. The surface drainage is thorough to excessive, but the subdrainage is rather slow in places. The Olympic soils are residual in origin and derived from basic igneous rocks. In this area they come mainly from basalt, but from other basic rocks to some extent. The native vegetation is mostly fir, with a scattering of cedar, oak, maple, and smaller growths. Two types, the loam and the clay loam, are mapped in this area.

The surface soils of the Cascade series are brown, and in places dark brown, in the superficial layer, owing to forest humus, but when plowed and cultivated they have a brown to yellowish-brown color. They contain appreciable quantities of small iron concretions. The upper subsoil is brownish yellow to yellowish brown, noticeably compact, similar to or slightly heavier in texture than the surface soil, and generally more or less mottled with gray and with red and brown iron stains. The lower subsoil or substratum is pale yellow to dull yellow in color, in places somewhat mottled, and tends to be of finer texture and more friable in structure than the overlying material. The soils are of residual origin, and derived from basalt or similar volcanic rocks. The types occupy smoothly rolling to rough and hilly or mountainous areas, covered with forest. They receive a moderately heavy to heavy rainfall, and are leached of lime carbonate. Regional drainage is well developed to excessive but the soils have good water-holding capacity. They differ from the associated soils of the Olympic series in the more pronounced yellow color of the subsoil and substratum. As occurring in this county, they resemble the associated soils of the Melbourne series, which are derived from shale and sandstone.

The surface soils of the Melbourne series are brown, with yellowish-brown variations. The material of the immediate surface in virgin forested areas is dark chocolate brown in places, owing to the presence of relatively large quantities of organic matter, and a gray subsurface layer may be developed beneath the accumulation of organic matter under conditions of heavy rainfall. The subsoil is yellowish brown to pale yellow or dull yellow, normally mottled with yellow, rusty-brown, and red iron stains. It is generally somewhat

heavier in texture and more compact in structure than the surface soil. The underlying bedrock in this area is deeply covered with soil and rarely appears in the 3-foot profile. The Melbourne soils are residual in origin and are derived from sandstones and shales. The topography is sloping to hilly and in places steep and rough. The surface drainage is good to excessive, but subdrainage is somewhat retarded by the compact subsoil. The native covering in this county is mainly fir, with some cedar, oak, maple, dogwood, and smaller trees and brush. The material of both surface soil and subsoil is well leached, low in lime, and in places acid in reaction. It contains, especially in the surface soil, numerous small iron-cemented pellets, similar to those in the soils of the Aiken and the Olympic series. As mapped in this county, the types of the Melbourne series grade into the types of the Olympic and Cascade series.

The types included in the Carlton series have light-brown or grayish-brown soils, and a grayish-brown or light-brown subsoil, mottled in places with gray, brown, and yellow iron stains. The surface soils have a moderate to low content of organic matter, and carry a few iron-cemented pellets. Both surface soil and subsoil are without free lime and may give an acid reaction. The subsoil tends to be heavier in texture or more compact than the surface soil. Bedrock is generally deeply weathered and rarely outcrops or appears within 3 feet of the surface. The soils of this series are residual in origin and are derived from sandstone and shale. The topography is sloping to hilly and steep. The surface drainage is usually good, but in places subdrainage is restricted and seepage water comes to the surface. The soils are usually found on the lower slopes of the hills. The native covering consisted of fir, oak, maple and smaller trees, but much of the forest has been removed. The silt loam and silty clay loam of this series are found in this county. These soils usually occur under conditions of somewhat lower rainfall than those of the Melbourne series. In places they merge with the Melbourne soils without distinctive boundaries, and as mapped may include some Melbourne material. In certain localities areas are included consisting of soil grayer than typical, which may in future surveys be recognized as representing a distinct soil series.

The surface soils of the types composing the Willamette series are brown, ranging from light brown or medium brown to rather dark grayish brown when dry, to a rich brown tint when moist. The subsoil is similar or slightly lighter in color and somewhat heavier and, though readily permeable, more compact than the surface soil. The subsoil is without mottling, or but faintly mottled in the lower depths, and is noncalcareous. These soils are derived, through weathering, from old water-laid deposits lying well above the present flood plains of the streams. The materials are derived from

both igneous and sedimentary rocks. The topography is smooth and very gently rolling or undulating to nearly level. Drainage is usually good but not excessive. The areas consist in part of prairie and in part are forested with fir and oak. Only one type, the silt loam, occurs in this county.

The Hillsboro series includes types with brown to dark-brown soils and a lighter brown or yellowish-brown or dull-yellow subsoil, lighter in texture than the surface soil. The surface soil has a low to moderate content of organic matter. Both surface soil and subsoil are noncalcareous. The soils of this series are derived from old alluvial deposits. The material is of mixed origin, both basic igneous and sedimentary rocks being represented. This series, as mapped in this area, occurs on the margin of the terraces and adjoining the lower lying flood plains. The topography is gently sloping to nearly level. The surface drainage is good and subdrainage is excellent, much better than in the Willamette series. This series in places merges with the Willamette. The land is practically all under cultivation, and it is impossible to state with certainty what the native vegetation was. Only one type, the loam, was mapped.

The surface soils of the types included in the Amity series are light brown, grayish brown, or dark grayish brown. They have a rather low content of organic matter and are deficient in lime. The subsoil is compact and of brown, grayish-brown, or dull-brown color mottled with yellow, brown, and gray. The lower part in many places is somewhat lighter in color and texture and more friable than the upper subsoil. The subsoil is noncalcareous. Small brown or dark-brown iron concretions occur here and there in the surface soil and subsoil. The soils of this series are derived from old valley filling deposits washed from areas consisting mainly of basaltic and sedimentary rocks. The soils occur on flat valley plains and in shallow basinlike areas. Drainage, both surface and internal, is rather poor. The areas were originally prairie or sparsely forested with fir and oak. In color, drainage, and subsoil characteristics this series is intermediate between the Dayton and the Willamette series. It is represented in Washington County by one type, the silt loam.

The surface soils of the types in the Dayton series are light gray or light brownish gray to dark gray when dry, with a rather dark gray or more pronounced brownish color when moist. They are low in organic matter and deficient in lime, being usually acid in reaction. They are generally compact in structure and sticky when wet, and have a tendency to puddle when wet and to bake when dry. The subsurface layer or upper subsoil is bluish gray to drab and may be mottled with gray and with yellow and rusty-brown iron stains. This layer is heavy, compact, tough, relatively impervious to water, and noncalcareous. The lower subsoil is yellowish brown to drab

or mottled brown and is more friable. The soils of this series are derived from old valley filling deposits of mixed origin, mainly from basaltic and sedimentary rocks. They occupy flats and shallow basin-like areas with poor drainage. In their natural condition they consist of prairie areas or support a scattering growth of scrub oak or other small trees. The silt loam occurs in Washington County.

The surface soils of the types in the Chehalis series are medium brown to rather dark brown when dry and ordinarily have a richer brown color when moist. They are moderately high in organic matter and usually friable. The subsoil has a similar or slightly lighter brown color, with little or no mottling. It is friable and generally like the soil in texture, or includes stratified materials of various textures. Both surface soil and subsoil are noncalcareous. The material of this series consists of recent alluvial deposits transported by water from the higher lying areas of the region in which they occur. They occupy smooth, nearly level, or but slightly uneven flood plains. Parts are sometimes overflowed during periods of high water, but for the most part they lie well above the normal stream flow. The drainage is otherwise good. They were originally heavily forested with fir, oak, maple, poplar, ash, willow, and other trees. Three types of this series are mapped, the loam, the silt loam, and the clay loam.

The Camas series includes types with medium-brown to dark-brown soils, of moderate organic content, resting upon an upper subsoil of similar or slightly lighter color, and in most areas like the surface soil in texture and structure. It may consist, however, of stratified deposits of different textures. The lower subsoil and substratum consist of loose gravels with a small admixture of sandy and finer material. In this area the gravel is composed mainly of basalt. The series is derived from recent alluvial deposits of mixed origin, but apparently containing a large proportion of materials from basic igneous rock. It has a typical flood plain topography and is mostly well drained, but is in part subject to overflow during periods of high water. The native vegetation is similar to that on the Chehalis soils. This series differs from the Chehalis series in having a gravel subsoil and substratum, giving it better underdrainage. Only one type, the loam, is mapped in Washington County.

The surface soils of the types included in the Wapato series are dark brown or dark grayish brown, becoming dark gray when dry. They usually have a moderate content of organic matter, contain very little lime, and in places give an acid reaction. The subsoil is dark brown or dark grayish brown to drab and usually mottled with yellow, drab, and brown iron stains. The Wapato soils consist of recent-alluvial material transported from areas of soils that are derived from basalt, sandstone, and shale. They have a level flood-

plain topography. They are subject to overflow and have poor drainage in places. The native vegetation was mostly water-loving trees and shrubs. Two types, the silt loam and the silty clay loam, are mapped in this county.

The Whiteson series includes alluvial types with light-gray to rather dark gray or brownish-gray soil, typically low in organic matter, resting on a subsoil of gray or light gray to drab, mottled with yellow and brown iron stains. The series occupies low flood plains and local flats, and is derived from deposits of mixed origin, including both basaltic and sedimentary rocks. The surface is flat and smooth, and the types are poorly drained and subject to overflow. Both surface soil and subsoil contain little or no lime, and in places give an acid reaction. One type, the silt loam, was mapped in this county.

The following table gives the actual and relative extent of the several soil types mapped:

*Areas of different soils.*

| Soil. | Acres. | Per cent. | Soil. | Acres. | Per cent. |
|---|---|---|---|---|---|
| Rough mountainous land | 175,872 | 37.6 | Carlton silt loam | 2,688 | 0.6 |
| Willamette loam | 65,792 | 14.1 | Muck and Peat | 2,624 | .6 |
| Melbourne loam | 57,664 | 12.3 | Carlton silty clay loam | 2,432 | .5 |
| Olympic loam | 33,792 | 7.2 | Chehalis clay loam | 2,368 | .5 |
| Amity silt loam | 31,808 | 6.8 | Camas loam | 1,664 | .4 |
| Wapato silty clay loam | 21,952 | 4.7 | Aiken clay loam | 1,344 | .3 |
| Olympic clay loam | 21,440 | 4.6 | Melbourne clay | 1,280 | .3 |
| Chehalis silt loam | 19,456 | 4.1 | Dayton silt loam | 1,024 | .2 |
| Cascade silt loam | 13,312 | 2.8 | Chehalis loam | 1,024 | .2 |
| Aiken silty clay loam | 3,904 | .8 | Whiteson silt loam | 192 | .1 |
| Hillsboro loam | 3,520 | .7 | | | |
| Wapato silt loam | 2,688 | .6 | Total | 467,840 | ..... |

AIKEN SILTY CLAY LOAM.

The surface soil of the Aiken silty clay loam is a brownish-red or dull-red to deep-red silty clay loam, 10 to 14 inches deep. In places it is rather light in texture and includes some areas of silt loam. It has only a fair supply of organic matter and is acid in reaction. It is friable and easy to cultivate, and with proper cultivation retains moisture moderately well. In the upper few inches the soil carries numerous small, roundish aggregates of soil particles cemented together, at least in part, by iron oxides and hydroxides. The subsoil to a depth of 3 feet is a pale-red or yellowish-red to deep-red clay loam, silty clay loam, or clay, in places quite compact. Bedrock is encountered in places within 2 or 3 feet of the surface and in a few places it outcrops, but generally the parent rock is very

deeply weathered. It is a hard basalt, and in a few exposures shows the typical columnar structure.

Rock outcrops occur in places in the southeastern corner of the county, producing a shallow stony soil that has a low agricultural value.

This type as mapped includes some small bodies of Aiken loam and Aiken silt loam and possibly some soils of the Olympic series. In places it is difficult to draw the boundaries of the soil types accurately because of the dense forest.

This type occurs in small isolated bodies near the southeastern border of the county, along the east side of Dairy Creek, and north and northwest of Banks and Buxton. It is not an extensive type. The topography is rolling to hilly, and is steep and rough in places. The more gently sloping, arable parts occur for the most part on the tops of ridges or on the lower slopes and smaller hills. Erosion must be guarded against, but it is not as serious as the topography would indicate. Surface drainage is good to excessive, and subdrainage fairly efficient.

This type was originally covered with a heavy growth of forest consisting of Douglas fir, cedar, maple, oak, and smaller undergrowth. Most of it has been cleared and brought under cultivation. It is naturally a productive soil, and all farm crops give good returns on newly cleared areas. Long-continued growing of small grains on parts of the type has left it in a depleted condition. The chief deficiency in these worn soils is organic matter. It is a good fruit soil; prunes, walnuts, cherries, apples, and pears do well on it. The areas in field crops are benefited by additions of lime and organic matter.

### AIKEN CLAY LOAM.

The surface soil of the Aiken clay loam is usually 8 to 10 inches deep and a clay loam in texture, but as mapped, some areas of heavier clay texture are included. The color when moist is red or brownish red to dull red and when dry reddish brown. It is a friable soil and, considering its heavy texture, is not difficult to cultivate. It contains only a moderate amount of organic matter, is rather sticky where wet, and is acid in reaction. It contains numerous small iron concretions. The subsoil is a clay loam or clay, quite compact, usually bright red or yellowish red, and low in lime. In most places the bedrock—a hard fine-grained basalt—is deeply weathered and in a very few places it comes within 3 feet of the surface.

A few small bodies of this type are situated in the hills in the northeastern part of the county, and one small body south of Laurel View School extends into the southern part of the county from Yamhill County. The surface is rolling to steep and hilly and

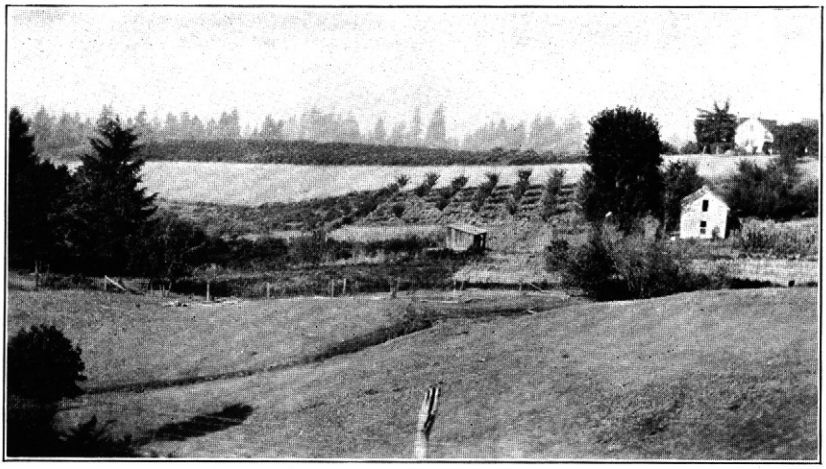

FIG. 1.—TOPOGRAPHY OF THE OLYMPIC LOAM IN THE DAVID HILL DISTRICT.

FIG. 2.—VINEYARD ON THE OLYMPIC LOAM IN THE DAVID HILL DISTRICT.

the agricultural value of the land depends on topography more than any other factor. Surface drainage is good, but subdrainage is restricted by the compact subsoil. Erosion must be guarded against.

This type was originally all heavily forested, mainly with fir. Owing to its small extent this is an unimportant type in this county, but it is a highly prized soil, and most of it is under cultivation. All farm crops give good yields, and fruits do especially well on it. It is considered a fine soil for prunes, walnuts, and cherries.

Fields which have been kept in grain for years have had their productiveness very much lowered, as in case of the silty clay loam, and the steps suggested for the improvement of that soil apply equally well to this.

### OLYMPIC LOAM.

The surface soil of the Olympic loam is a somewhat reddish or rusty-brown to rather dark brown loam, the depth of color varying with the content of organic matter. In most places the soil contains an appreciable quantity of small iron concretion and occasional small fragments of partly weathered basalt. As a rule the soil has a smooth silty texture, in places approaching closely a silt loam. The soil has a moderate content of organic matter, is retentive of moisture, and is friable and easily maintained in good physical condition.

The subsoil, encountered at a depth of 8 to 12 inches, is generally somewhat lighter brown or more red than the soil. It is slightly more compact than the surface soil, but is friable and readily permeated by water. The parent rock is generally deeply weathered, exposures being rare, but some areas of shallow and stony soil occur, the stone consisting of outcrops and rock fragments. These areas, which have a lower agricultural value, are indicated on the map by rock-outcrop symbols.

As mapped the type may include locally some material of the Cascade and the Melbourne series.

The Olympic loam, which is one of the more extensive soils, is developed mainly in the central, western, and northern parts of the county. It occupies part of Cooper Mountain and adjacent lower lying hills. Other conspicuous areas occur in the vicinity of and northeast of the Meacham School, northwest of Schofield and north and northwest of Gales Creek.

The topography is rolling to hilly, but the surface is generally smooth. (Pl. XLIII, figs. 1 and 2.) Nearly all of the slopes can be cultivated, though some of the steeper hill slopes can be cultivated only with difficulty and are better adapted to forestry and pasture than to farming. Surface drainage is good to excessive, and erosion must be guarded against; but because the soil is readily permeable and

the rains are usually gentle, apparently but little damage has been done through erosion. The type in its native state is heavily forested, mainly with Douglas fir. Parts have been cleared and are utilized for grain, hay, and forage crops and for prunes and other tree fruits. The type is productive under favorable conditions, though the content of organic matter is depleted rather rapidly where the land is devoted to continuous grain growing. In places the soil appears to be deficient in lime.

The older cleared and developed areas are well supplied with highways, but in the forested and newer cut-over areas roads are either wanting or are poor and agricultural development has been retarded.

### OLYMPIC CLAY LOAM.

The surface soil of the Olympic clay loam is a brown or dull reddish brown clay loam, relatively high in silt, 10 to 12 inches deep. It has a moderate content of organic matter and is friable and easy to cultivate. It contains considerable quantities of small spherical pellets or iron concretions. It is fairly retentive of moisture. It is deficient in lime and acid in reaction. In some areas the soil is rather light, approaching a loam or silt loam in texture. The subsoil to a depth of 3 feet or more is a brown to reddish-brown or red clay loam or silty clay loam, more compact than the surface but not to a degree to impede the movement of moisture. There is apparently no free lime in the subsoil. The parent rock, consisting mainly of a hard fine-grained basalt, generally lies below a depth of 3 feet. In a few places, however, the soil material is shallow, and the areas are marked by rounded outcrops of the bedrock and by loose bowlders wholly or partly embedded in the soil material. The more extensive of these areas are shown on the map by symbols.

As mapped in this area the type includes some Aiken material, some areas of the associated Cascade soils, and some material of the Melbourne series.

The Olympic clay loam is most extensively developed in the southeastern part of the county, where it joins with areas of this type in Yamhill County.

The topography is mainly gently rolling to steep and hilly, but the surface is generally smooth and most of the land can be farmed. In places the type occupies the higher hill slopes, lying above the Melbourne and Carlton soils; in other places it entirely covers the hills on which it occurs.

Notwithstanding the hilly topography erosion is not active. This is due apparently to the permeability of the soil and to the character of the rains, which are usually slow and gentle. The drainage, both of the surface soil and subsoil, is excellent.

This type was apparently once all covered with a forest in which the Douglas fir was dominant, and only a relatively small part of the type has been cleared and farmed. It is a valuable soil and gives good returns when brought under cultivation. Development is hindered by the cost of clearing and in many places by the steep topography. The part cleared lies mostly on the lower slopes of the hills adjacent to the valley. The type is recognized as an excellent soil for fruit, prunes doing especially well on it. Grain, clover, vetch, and potatoes are grown to a small extent and give moderate to large yields.

To get the best returns from this soil it is necessary that the content of organic matter be maintained or increased. To do this, the growing of legumes is essential. Much of the type is acid and is benefited by the application of lime. Two tons of ground limestone per acre would probably be sufficient for the first application. Fields that have been cropped to grain for a long time are found to respond to applications of acid phosphate, and red clover has been found to be benefited when treated with gypsum. These fertilizers are therefore recommended under these conditions.

### CASCADE SILT LOAM.

The surface soil of the Cascade silt loam in virgin forested areas to a depth of several inches is medium brown to rather dark brown in color, which varies with the content of humus, in most places fairly high. Below this layer, and in plowed or cultivated fields, it is medium brown to light brown or slightly yellowish brown. It contains some shotlike iron-cemented pellets and occasional small fragments of partly weathered basalt. The upper subsoil is brownish yellow or dull yellow to yellowish brown, generally somewhat mottled with gray and in places slightly with iron stains. It is normally more compact or slightly heavier than the surface soil. The material of the lower subsoil, which generally extends to a considerable depth, is pale yellow to dull yellow in color, more or less mottled in places, and tends to be less compact in structure and lighter in texture. The parent rock is usually deeply weathered and is rarely exposed. Where bedrock is exposed it is usually weathered to such an extent that it is difficult to identify, and the areas may include some materials of the Melbourne or the Olympic series having an entirely different rock origin.

The type covers extensive areas in the eastern and northeastern parts of the county. It occupies sloping to hilly and mountainous areas. The slopes are usually smooth and not greatly eroded. The more gentle are favorable to cultivation, but the steeper slopes can not be successfully cultivated, or can be tilled only with difficulty.

Surface drainage is well developed and in many places is excessive, but subdrainage is much less free.

In its virgin state the type is heavily forested, chiefly with fir. Much of the type is still in native or second-growth trees. The cost of clearing cut-over land of brush and stumps is high, but rather large areas have been cleared. These are used mainly for the production of grain and hay crops and potatoes, but to some extent for prunes and other tree fruits.

Where cropped continuously to grain the surface soil is rather rapidly depleted of the humus and steps should be taken to increase the supply. The type is deficient in lime. The use of stable and green manures and the application of lime or gypsum generally result in improved yields.

MELBOURNE LOAM.

The surface soil of the Melbourne loam is a brown to light-brown or yellowish-brown loam, 10 to 15 inches deep. The subsoil, extending to the depth of 3 feet or more, is of similar or slightly heavier texture than the soil, somewhat compact and yellowish brown or pale yellow to dull yellow in color. It grades into a substratum slightly lighter in texture and more friable, and varying in color from brown to yellowish brown or yellow.

It is friable in structure, easy to cultivate, and retentive of moisture. It does not contain much organic matter, although the material of the immediate surface in places contains considerable, enough to make it dark colored. It is deficient in lime and in places is slightly acid in reaction. In the first few inches the soil contains numerous shotlike aggregates of soil material cemented together, probably mainly with iron oxides and hydroxides. The subsoil and substratum are well leached of lime. Bedrock occurs within 3 feet of the surface in very few places; commonly it is very deeply weathered. It consists of gray and brown sandy shale and fine-textured sandstone.

This type includes spots of grayish-brown soil underlain with a gray or drab subsoil. If larger, these would have been mapped as Carlton soils. Some areas of Olympic and Cascade types also are included. Other variations consist mostly of difference in texture, which may be either lighter or heavier than typical.

The Melbourne loam has a rather wide distribution. It is generally developed on the lower and more gentle slopes of hills, but is also found on their crests. The topography is rolling to hilly. Most of the areas of this type are tillable. The soil nearly everywhere is deep enough to make first-class agricultural soil; the limiting factor is topography. Erosion is not as serious as the topography would lead one to expect. The drainage is excellent.

The soil was originally covered with a heavy forest, chiefly Douglas fir, but with some cedar, maple, dogwood, and lesser growths. The high cost of clearing the land of stumps has been a factor in retarding its development. Probably less than half is cleared and farmed. All the ordinary farm crops, including small grains, potatoes, and hops, are grown, and give medium to very good yields. Some successful prune orchards are located on this soil. A wide variety of fruits can be grown upon it.

The first essential in maintaining and increasing the productiveness of this soil is to increase the content of organic matter. This can best be done by adding lime to neutralize the acidity, and then growing legumes for green manure or cover crops. All stable manure should be carefully saved and applied. On soils that have been depleted by long-continued grain farming, acid phosphate has been found to give good results. Gypsum has also increased the returns when used on legumes.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Melbourne loam:

*Mechanical analyses of Melbourne loam.*

| Number. | Description. | Fine gravel. | Coarse sand. | Medium sand. | Fine sand. | Very fine sand. | Silt. | Clay. |
|---|---|---|---|---|---|---|---|---|
| | | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| 560944 | Soil | 0.4 | 0.8 | 1.1 | 9.5 | 38.6 | 37.9 | 11.4 |
| 560945 | Subsoil | .0 | .3 | .8 | 9.9 | 37.7 | 39.5 | 11.9 |

MELBOURNE CLAY.

The surface soil of the Melbourne clay is a brown or yellowish-brown clay 8 to 12 inches deep. It is rather light in texture, contains considerable silt and fine sandy material, and is friable in structure and easy to cultivate. It has a medium to low content of organic matter, is low in lime, and in places gives an acid reaction. In the surface few inches the soil contains a considerable quantity of small iron concretions. The subsoil in its typical development to a depth of 3 feet or more is a silty clay or clay, rather compact in structure, yellowish brown or yellow in color, and in most places somewhat mottled. The subsoil grades into a substratum, which in places is lighter in texture. The parent rock is generally very deeply weathered, but in a very few places it comes within 3 feet of the surface. It consists of shale and fine-grained sandstone.

As mapped in Washington County the type appears to average somewhat lighter in texture than is typical, in places approaching a clay loam or loam, and it is probable that locally some areas of these lighter textured types are included.

This type is found only in the central western and southwestern parts of the county, southwest of Forest Grove on the lower hills bordering Tualatin River, and northwest of Forest Grove on the low hills bordering Gales Creek. The Melbourne clay has a rolling to hilly topography. Its value varies mainly with the degree of steepness of the slopes. Surface drainage is good to excessive and subdrainage is fair. There is some erosion, but it is not a serious problem. The original vegetation was a heavy forest, mainly Douglas fir. Much of this type is still uncleared. Small grain, potatoes, hops, and other farm crops are grown and give medium to high yields. It is considered an excellent soil for fruit.

This soil needs lime and organic matter. Every effort should be made to increase the supply of the latter. Where legumes can be grown profitably they are probably the best crops for the purpose. Soil in acid condition should be sweetened by the application of lime, before sowing the legume crop.

### CARLTON SILT LOAM.

The surface soil of the Carlton silt loam, about 9 to 12 inches deep, is a light grayish brown silt loam, with variations in which the color shades to brown in places and to gray in others. Generally it is rather plastic, easily puddled, and rather difficult to maintain in good tilth. It has a medium to low content of organic matter, and in places contains a few iron-cemented pellets, but is generally without gravel or rock fragments. It is well leached and more or less acid in reaction. The subsoil, to a depth of 3 feet or more, is a yellowish-brown or grayish-brown silt loam or silty clay loam, in many places mottled. It is rather compact and sticky when wet, and slightly heavier than the surface soil. Like the soil, it is noncalcareous.

The Carlton silt loam is derived from soft sandstone and shale rocks or shaly material, but as mapped in this area it probably includes some small areas of alluvial fan and footslope deposits, the material of which has been washed down from the hill. The line of demarcation between this type and others with which it is associated is usually indistinct, and in places the soil boundaries are rather arbitrarily drawn. Local areas have a pronounced gray color, and probably some of these represent material not yet included in a named series of soils.

The Carlton silt loam occurs in small bodies scattered over the county, lying, as a rule, just above the old valley filling soils and at the base of the higher hills. As a rule it is bordered on the upper side by the Melbourne loam. It has a sloping to gently rolling topography, usually with a smooth surface, though erosion has cut it in a few places. It has good surface drainage generally, but is poorly drained locally and is subject to seepage from the higher lying soils.

The native forest vegetation was mostly oak and fir. About two-thirds of the type has been cleared. A good deal of it is pasture. Oats, wheat, and fruit are the main crops. The yields are moderate to low.

In places this soil needs draining. It would be improved also by an application of lime now and then. The content of organic matter should be increased. This may be done by applying barnyard manure or by plowing under green-manure crops.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

*Mechanical analyses of Carlton silt loam.*

| Number. | Description. | Fine gravel. | Coarse sand. | Medium sand. | Fine sand. | Very fine sand. | Silt. | Clay. |
|---|---|---|---|---|---|---|---|---|
| | | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| 560936 | Soil | 0.1 | 1.6 | 0.8 | 1.8 | 16.3 | 62.9 | 16.4 |
| 560937 | Subsoil | .0 | .2 | .3 | 4.5 | 18.4 | 64.0 | 12.6 |

CARLTON SILTY CLAY LOAM.

The surface soil of the Carlton silty clay loam is a grayish-brown or dark grayish brown silty clay loam, averaging about 10 inches in depth. It is sticky and plastic when wet and tends to bake and form clods when dry. It has a medium to low content of organic matter, is deficient in lime and in places gives an acid reaction. The subsoil to a depth of 3 feet or more is yellowish brown or grayish brown in color and generally similar to or slightly heavier than the surface soil.

This type is found in small areas near Forest Grove in the central-southern part of the county. It occurs on the lower hills and the footslopes of the higher hills. The surface is sloping to gently rolling and is cut by erosion in only a few places. Surface drainage is generally well developed, but is deficient locally, and subdrainage is restricted by a compact subsoil. The underlying rocks are very deeply weathered, and it is therefore difficult to establish its boundary with accuracy where the type is associated with similarly colored soils derived from other materials, and the boundary between it and the Melbourne soil, which usually lies above it, is sometimes arbitrarily drawn.

This type is of small extent and is considered an inferior soil. Less than half of it is under cultivation. Small grains are the chief crops, and the yields are low to moderate. Much of the type is in pasture.

This soil may be improved by the installataion of tile drainage where needed to cut off seepage water, the application of lime for the correction of acidity, and an increase in the content of organic matter.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the type:

*Mechanical analyses of Carlton silty clay loam.*

| Number. | Description. | Fine gravel. | Coarse sand. | Medium sand. | Fine sand. | Very fine sand. | Silt. | Clay. |
|---|---|---|---|---|---|---|---|---|
| | | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| 560917 | Soil | 0.1 | 0.2 | 0.3 | 1.7 | 15.1 | 61.7 | 21.2 |
| 560918 | Subsoil | .0 | .2 | .4 | 3.7 | 15.5 | 63.8 | 15 6 |

WILLAMETTE LOAM.

The surface soil of the Willamette loam is a brown loam 10 to 15 inches deep. Conspicuous variations in either color or texture are rare, but when moist some of it assumes a chocolate or reddish-brown color. It has a granulated structure and is friable and easy to cultivate. It contains only a moderate amount of organic matter, has a low lime content, and is usually mildy acid. It retains moisture well. Cemented shotlike pellets occur in places. The subsoil to a depth of 3 feet or more, is a silt loam or silty clay loam, usually compact. The color is brown or reddish brown, the same shade as the surface soil or a little lighter, with little or no mottling. It is noncalcareous. The substratum below 3 feet is less compact and more friable and in some places, especially near stream bottoms, is appreciably lighter in texture. As mapped the type may include some Hillsboro loam. Traces of hardpan are found under low-lying parts of this type, but it is apparently intermittent and of little consequence. Where mapped near the hills this soil is shallow in places, and the line between it and the residual soils is often difficult to determine. The type is usually without stone or gravel, but in the vicinity of Tualatin in the Tualatin River valley it apparently occupies an old stream channel in which large basaltic bowlders occur.

The Willamette loam is well distributed over the main valley of the county, with minor bodies lying in some of the smaller valleys. It extends in large bodies over the main valley floor, with occasional interruption by narrow strips of recent-alluvial soils. It occupies the valley plains and low terraces or benches 10 to 25 feet above the flood plains of the main streams. Some of the smaller streams flowing across it have flood plains only a foot or two below the general level of this soil. Its surface is that of a plain with shallow drainage channels cut back into it, so that all parts have good drainage. The slopes are smooth and gentle, except on low bluffs bordering the larger streams. Its favorable natural drainage, and its permeable subsoil suited to retain moisture during the frequent droughts, are important factors in the productiveness and utilization of this soil.

The native vegetation was in part forest, consisting of fir, pine, and oak, and in part grasses, but in the present stage of agricultural development it is impossible to tell just how large the native prairies were or where they were situated.

The Willamette loam is an extensive type, and from an agricultural standpoint the most important type in the county. Practically all of it is under cultivation. It is surpassed in fertility only by the better drained of the recent-alluvial soils. It is adapted to all the main farm crops grown in the county. The principal crops are wheat, oats, red clover, oat and vetch hay, corn and potatoes. Hops have been an important crop, but are now grown very little on account of the curtailed market. Clover is grown both for hay and seed. Corn is grown for silage. Potatoes, other vegetables, and fruit for home consumption are produced on nearly every farm.

Dairying is the prevailing industry. It is well suited to this soil. The cows are pastured to some extent, but are mainly fed with freshly cut clover or vetch. They are carried through the winter on clover hay, vetch hay, and silage, supplemented with mill feeds.

The yields of wheat and oats are good. Clover averages about 2 tons of hay and 2 to 7 bushels of seed per acre. Wheat and vetch, or oats and vetch, yield from 2 to 4 tons of hay.

The region where this type predominates is well supplied with roads. Houses are frequent and there are plenty of schools and trading centers. The comfortable houses, barns, and well-kept farms indicate the prosperity of these farmers. The land is valued at $100 to $150 and in some cases $200 an acre, depending upon improvements and distance from markets.

To keep up the productivity of this soil it will be necessary to maintain the supply of organic matter by using all available barnyard manure and plowing under clover and vetch as green manure. It seems certain that an application of lime, about 2 tons per acre, would be profitable as it would aid in the growing of legumes. The addition of a small quantity of gypsum on clover has been found helpful. The Oregon Agricultural Experiment Station recommends the use of superphosphate for field crops.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

*Mechanical analyses of Willamette loam.*

| Number. | Description. | Fine gravel. | Coarse sand. | Medium sand. | Fine sand | Very fine sand. | Silt. | Clay. |
|---|---|---|---|---|---|---|---|---|
| | | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| 560942 | Soil | 0.0 | 0.9 | 0.8 | 6.8 | 31.1 | 48.0 | 11.4 |
| 560943 | Subsoil | .0 | .3 | .3 | 4.1 | 31.2 | 52.2 | 11.9 |

HILLSBORO LOAM.

The surface soil of the Hillsboro loam is a brown to rather dark brown loam. It has an average depth of 12 inches. It is mellow and friable and easy to cultivate, has a fair to good supply of organic matter, and retains moisture fairly well. It is neutral or slightly acid in reaction. The subsoil, to a depth of 2 to 3 feet, is in most places a little lighter colored than the surface soil, being light brown or yellowish brown. The texture is similar to or a little lighter than that of the surface layer. The lower subsoil, where the material described above extends to less than 3 feet, and the substratum are a light-brown or yellowish-brown to dull-yellow fine sandy loam or fine sand.

This type occurs between Forest Grove and Hillsboro, where it occupies an area of several square miles on a terrace on the north side of the Tualatin River. This area is essentially a single large body, being interrupted by only a few narrow strips of lower lying recent alluvial soils.

The surface, which is nearly smooth to slightly undulating, slopes gently toward the Chehalis and Wapato soils lying along the stream channels.

The type merges into the Willamette loam; it is in fact composed of a superficial deposit of Willamette material upon lighter textured materials forming the low bluff at the edge of the terrace.

The type is very little affected by erosion, is generally very well drained, and has especially good subdrainage. It is well suited to irrigation on account of the smooth level surface and the effective subdrainage.

The Hillsboro loam is of small extent but is a valuable soil. Practically all of it is under cultivation. The crops are small grains, corn, potatoes, hops, various truck crops, vetch, and clover, and yields from all these are high when proper cultural methods are used. Suggestions for improvement are the same as for the Willamette loam.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

*Mechanical analyses of Hillsboro loam.*

| Number. | Description. | Fine gravel. | Coarse sand. | Medium sand. | Fine sand. | Very fine sand. | Silt. | Clay. |
|---|---|---|---|---|---|---|---|---|
| | | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| 560921 | Soil | 0.0 | 0.4 | 0.3 | 6.0 | 28.3 | 44.1 | 20.7 |
| 560922 | Subsoil | .1 | .3 | 1.3 | 17.3 | 33.8 | 37.1 | 10.3 |

AMITY SILT LOAM.

The surface soil of the Amity silt loam is a brown or grayish-brown to rather dark grayish brown silt loam of rather heavy texture, 8 to 12 inches deep. It is sticky when wet and has a tendency to bake, but under favorable moisture conditions is friable and easy to cultivate if handled properly. It has a low to moderate supply of organic matter, is well leached of soluble minerals, and is generally acid in reaction. It usually contains some small iron-cemented pellets. The subsoil, to a depth of 30 or 36 inches, is a heavy silt loam or silty clay loam, yellowish brown or grayish brown in color, mottled with iron stains, and moderately compact in structure. The substratum is in most areas somewhat lighter in texture and less compact than the subsoil.

This type is scattered over the valley part of the county, usually as small irregular-shaped areas associated with the Willamette loam. The more important areas occur in the vicinity of Hillsboro, Beaverton, and Orenco. It occupies flat or basin-like areas on terraces, at some distance from the main stream.

The surface is smooth or is formed of alternating swells and shallow depressions.

The soil occurring upon the swells is browner and approaches in character the Willamette loam. That of the depressions is grayer and more like the Dayton silt loam. This type is in fact intermediate between those two soils. The surface drainage is poor, owing to the flat surface, and the subdrainage is restricted by the heavy texture and compact structure of the subsoil. In the poorer drained areas the mottling in the subsoil is much more pronounced and may reach to within 12 inches of the surface, while in the better drained the mottling is less pronounced and may be confined to the part below 30 inches.

Apparently much of this type was originally prairie, but some of it was forested with fir and oak. Nearly all of it is now under cultivation. All the farm crops common in the county are grown. On artificially drained areas the yields are good if the season is favorable.

The crops are more readily affected by drought than on the Willamette loam. In seasons of favorable rainfall the yields on the two soils are about the same, but in general the Amity silt loam is less productive. The main crops are wheat, oats, vetch hay, and vetch seed. Fruits and vegetables are grown for home consumption. Corn is grown for silage. Dairying is the principal type of farming followed on the farms located wholly or in part on this soil. Roads are plentiful and fairly well maintained.

Thorough tile drainage is the first thing necessary to improve this soil. About 2 tons of lime per acre should be applied to correct the acidity. The content of organic matter in the soil should be maintained and increased by applying all available stable manure, and plowing under green manures. Gypsum has been found to improve the growth of clover when applied at the rate of 40 to 60 pounds per acre as a top dressing in the spring before the rains have ceased.

The following table gives the results of mechanical analysis of a sample of the surface soil of this type:

*Mechanical analysis of Amity silt loam.*

| Number. | Description. | Fine gravel. | Coarse sand. | Medium sand. | Fine sand. | Very fine sand. | Silt. | Clay. |
|---|---|---|---|---|---|---|---|---|
| | | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| 560938..... | Soil..... | 0.3 | 1.0 | 0.4 | 2.2 | 25.1 | 50.7 | 20.5 |

DAYTON SILT LOAM.

The surface soil of the Dayton silt loam is light-gray, brownish-gray, or dull-gray silt loam or heavy silt loam, 10 to 20 inches deep, in which iron-cemented pellets are conspicuous. As a rule the soil is low in organic matter and not well granulated. It is sticky when wet, and unless handled skillfully it puddles, bakes, and is difficult to cultivate. It is not very retentive of moisture and does not stand drought well. When dry field surfaces have an ashy appearance, and the type is known locally as "white land." As mapped in this area the type includes some variations of dark-gray or grayish-brown color.

The soil is deficient in lime, giving an acid reaction by the litmus-paper test.

The subsoil consists of two horizons. The upper one is dark gray or drab, usually somewhat mottled, and generally is a tough, compact, silty clay, sufficiently compact to retard the movement of soil water very materially.

This layer is encountered between 10 and 20 inches below the surface and is ordinarily from 6 to 12 inches thick. The lower subsoil is somewhat lighter in texture, much less compact, and of yellowish-brown color, mottled with gray and with yellow and brown iron stains. This material extends to a depth of 3 feet or more.

The Dayton silt loam covers a small part of Washington County. One small area is situated northwest of Beaverton and another north of Schefflin. It occurs as basinlike or flat, poorly drained areas within areas of the Willamette loam or the Amity silt loam, which lie a little higher. The surface drainage is poor, and the

subdrainage, owing to the heavy compact subsoil, is restricted. The farmers state that the land dries out very slowly in the spring.

The type is considered one of the least desirable soils in the county. Uncleared areas have a covering consisting mainly of scrub oak and underbrush. Some of the type was originally prairie. Much of it is kept in pasture. A mixture of oats and vetch is sometimes grown. Corn does well on this type when drained and manured.

The first thing necessary for the improvement of this soil is thorough tile drainage. Applications of lime would also be beneficial, as the soil shows evidence of acidity. It also needs more organic matter. This can be supplied by using stable manure or by turning under clover or other green manures. This would make the structure more open and improve the internal drainage.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of this type:

*Mechanical analyses of Dayton silt loam.*

| Number. | Description. | Fine gravel. | Coarse sand. | Medium sand. | Fine sand. | Very fine sand. | Silt. | Clay. |
|---|---|---|---|---|---|---|---|---|
| | | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent* | *Per cent.* |
| 560933 | Soil | 0.1 | 0.4 | 0.2 | 5.0 | 28.2 | 47.7 | 18.5 |
| 560934 | Subsoil | .1 | .5 | .4 | 6.1 | 23.9 | 49.6 | 19.5 |
| 560935 | Lower subsoil. | .0 | .8 | .6 | 9.0 | 27.5 | 52.9 | 9.3 |

CHEHALIS LOAM.

The surface soil of the Chehalis loam is a rich-brown to dull-brown, mellow, friable loam, 10 to 18 inches deep. It has a moderate content of organic matter, retains moisture quite well, and is easy to cultivate. In places it has a rather light fine sandy texture. The subsoil to a depth of 3 feet or more is very similar to the surface soil, being a brown or reddish-brown silty loam, in most places slightly lighter in color than the surface soil and slightly mottled here and there with iron stains. In some areas the texture is somewhat heavier than that of the surface soil. The soil is noncalcareous.

As mapped in this area, the Chehalis loam varies widely in texture. Small strips and irregular-shaped bodies of fine sandy loam and silt loam are included. These variations are apparently due to the varying currents which laid the soil down. The variations cover such small areas that it was not possible to show them on the map.

This is a first-bottom soil occurring in small scattered areas upon the flood plain of the Tualatin River from near Hillsboro to Cherry Grove. It has a level or slightly uneven surface. Most of it is well drained, but parts of it are subject to occasional overflow.

The type was originally covered with a forest consisting of fir, oak, maple, and an undergrowth of brush, but nearly all has been cleared, and most of it is now under cultivation. As this is a type of small extent, no distinctive systems of cropping and farm management have been established.

Wheat, oats, corn, red clover, and vetch (usually sown with wheat or oats) are the main crops. The yields are usually very satisfactory. A few peach orchards on this type are doing well. Most of this soil is included in dairy farms, and dairy farming is well suited for keeping up its productiveness. The content of organic matter should be maintained and increased. Deep plowing, careful cultivation, and tile drainage where needed are also important factors in keeping the fields in good condition.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

*Mechanical analyses of Chehalis loam.*

| Number. | Description. | Fine gravel. | Coarse sand. | Medium sand. | Fine sand. | Very fine sand. | Silt. | Clay. |
|---|---|---|---|---|---|---|---|---|
| | | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| 560915 | Soil | 3.2 | 12.4 | 5.8 | 20.0 | 11.6 | 34.6 | 13.0 |
| 560916 | Subsoil | 1.0 | 5.1 | 3.2 | 10.8 | 14.2 | 48.5 | 16.7 |

CHEHALIS SILT LOAM.

The surface soil of the Chehalis silt loam to a depth of 12 to 18 inches is a dull-brown to rich reddish brown, mellow, friable silt loam 12 to 18 inches deep. It is well supplied with organic matter, is retentive of moisture, free from gravel, and easy to work.

The subsoil, which extends to a depth of 3 feet and usually to a much greater depth, is very similar to the surface soil, being a brown or reddish-brown silt loam; in places it is a trifle lighter colored than the surface soil, and here and there somewhat heavier or lighter in texture. Litmus tests show slight acidity.

This first-bottom soil is well distributed over the valley part of the county. The more important areas occur along the larger streams. Large bodies are situated in the bottoms of the Tualatin River and its main tributaries. The type also occurs on the bottoms of the Nehalem River, where it leaves the county on the northwestern boundary. Other small bodies occur along the small streams in the hilly and mountainous parts of the county.

The type has a level and smooth or very slightly irregular surface. Both surface drainage and subdrainage are good. The areas lie mainly on somewhat older bottoms standing above the most recent flood plains, or along streams that have cut their channels so deep

that the bottoms are mainly above overflow, though low-lying areas are subject to occasional flooding.

The Chehalis silt loam was originally covered with a forest, mainly fir, oak, maple, and brush; but this has nearly all been cleared off. Probably 80 per cent of the type is under cultivation. It is considered one of the best soils in the county. Although not as extensive as the Willamette loam, it is a very important type. Wheat, oats, red clover, and vetch (usually sown with oats), hops, and corn are the main crops. The yields are relatively large. Potatoes and other truck crops also are grown to some extent. Areas of this type usually are farmed in conjunction with other types, no separate system of farm management having been worked out. Most of the areas are included in dairy farms, and the crops grown on this soil are used to feed the cows. As dairy farming includes the growing of clover and vetch, and the return of the manure to the soil, the productiveness of the land is well maintained. The methods of farming are in the main well suited to the soil and any suggestions offered would be along the line of the practice of the better farmers, including deep tillage, well-planned rotations that include a legume, a careful return of all manure to the land, and installation of tile drainage where needed.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

*Mechanical analyses of Chehalis silt loam.*

| Number. | Description. | Fine gravel. | Coarse sand. | Medium sand. | Fine sand. | Very fine sand. | Silt. | Clay. |
|---|---|---|---|---|---|---|---|---|
| | | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| 560929 | Soil | 0.1 | 0.5 | 0.4 | 8.1 | 24.9 | 52.7 | 13.4 |
| 560930 | Subsoil | .0 | .2 | .3 | 7.8 | 32.5 | 45.7 | 13.5 |

CHEHALIS CLAY LOAM.

The surface soil of the Chehalis clay loam is a brown, reddish-brown or chocolate-brown clay loam of rather silty texture 10 to 14 inches deep. It is only moderately friable, is sticky when wet, and bakes when dry. It has a good supply of organic matter and retains moisture well. Chemical tests show it to be slightly acid. The subsoil to a depth of 3 feet or more is a clay loam or silty clay loam, in places a little heavier in texture than the surface soil and slightly compact. It is ordinarily a little lighter brown or a more pronounced reddish brown than the surface soil, and in some areas it is slightly mottled in the lower part.

As mapped in this county this type probably includes small bodies of the Wapato silty clay loam and the Cove clay.

Several small areas of this type are mapped in the northern part of the county on East Fork Dairy Creek near Mountain Dale. Other areas are found along the Tualatin River near Hillsboro, Forest Grove and Gaston, and one near the town of Gales Creek. The type occurs on the flood plains of streams and has a smooth or slightly undulating surface. Drainage, both surface and internal, is somewhat deficient in places and the areas are subject to annual overflow.

The Chehalis clay loam is largely cleared and farmed. It is a productive soil, but is somewhat difficult to handle because it is heavy in texture and late in drying out in the spring. The crops grown are mainly oats, wheat, corn, and alsike clover. The yields are not quite as large as on the Chehalis silt loam.

Suggestions for improvement include tile drainage where needed, deep and careful tillage, and a larger supply of organic matter obtained by using all available manure and growing and turning under leguminous crops.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

*Mechanical analyses of Chehalis clay loam.*

| Number. | Description. | Fine gravel. | Coarse sand. | Medium sand. | Fine sand. | Very fine sand. | Silt. | Clay. |
|---|---|---|---|---|---|---|---|---|
| | | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| 560919 | Soil | 0.8 | 4.1 | 2.9 | 12.0 | 18.2 | 42.8 | 19.9 |
| 560920 | Subsoil | .1 | 2.4 | 2.2 | 8.0 | 14.9 | 47.8 | 24.2 |

CAMAS LOAM.

The surface soil of the Camas loam is a brown to dark-brown or dark reddish brown loam 10 to 15 inches deep, rather silty in texture and containing some cobblestones and gravel. It is a mellow friable soil and easy to cultivate. It has a very good supply of organic matter and low content of lime, but does not appear to be very acid. The subsoil to an average depth of 20 to 36 inches is a brown loam very similar to the surface soil, except that its color is usually lighter and more red. It also may carry some gravel or cobblestones. Below this is a porous stratum which may extend to considerable depth. The gravel bed consists of hard rounded waterworn basalt fragments with little fine interstitial material. The depth at which this bed occurs is quite variable. In places it comes so near the surface as to be reached by the plow; in most places it is 2 feet or more below the surface, and in places it does not lie within the 3-foot profile, but it occurs everywhere at some depth. In consequence the value of the soil varies greatly. Where the gravel bed is well below the 3-foot level the soil is in physical characteris-

tics very similar to the Chehalis silt loam, retains moisture well, and gives good crop yields. Where the loose gravel occurs near the surface the soil is droughty and the crops are correspondingly poor.

As mapped in this survey the type includes some small areas of silt loam or clay loam texture, but these are too small to separate on the map. There is also a small area on lower Gales Creek in which the gravel has no covering of soil, and narrow bodies of this character border Gales Creek for some distance. These included areas are nonagricultural, and if more extensive would be mapped as River-wash.

This type occurs on the first bottoms of Gales Creek in the northwestern part of the county. It consists of recent-alluvial material deposited by this stream which receives most of its sediments from areas of igneous rocks.

It has a typical flood-plain topography; the surface is smooth, or marked in places by abandoned stream channels or slight elevations indicating old bars. Surface drainage is generally good and subdrainage thorough to excessive. Most of the type is subject to annual overflow, and all of it flooded during periods of unusually high water.

This type covers only a small total area. It is practically all cleared now, but was probably originally covered with forest. The remaining trees are fir, oak, poplar, ash, and willow. Most of the land is under cultivation. In agricultural value it is similar to the Chehalis silt loam, but where the gravel comes near the surface the yields are appreciably less.

The type is handled like the Chehalis silt loam and the recommendations for improvement of the soil are the same.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the type:

*Mechanical analyses of Camas loam.*

| Number. | Description. | Fine gravel. | Coarse sand. | Medium sand. | Fine sand. | Very fine sand. | Silt. | Clay. |
|---|---|---|---|---|---|---|---|---|
| | | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| 560931 | Soil | 0.3 | 3.4 | 3.1 | 15.6 | 15.1 | 41.2 | 21.5 |
| 560932 | Subsoil | .2 | 3.3 | 4.8 | 23.6 | 14.9 | 38.9 | 14.4 |

WAPATO SILT LOAM.

The surface soil of the Wapato silt loam is a dark-brown or dark grayish brown silt loam with an average depth of 12 inches. Where drained and under cultivation it has good granulation, and is easy to cultivate. It contains a fair to large porportion of organic matter. It is only mildly acid. The subsoil to a depth of 3 feet or more is

dark gray or drab, mottled with yellow and brown iron stains. It is normally similar to or slightly heavier in texture than the surface soil. It is somewhat compact, but offers no great resistance to the passage of water and the penetration of roots.

There are included with this type in the present survey a few bodies of the Chehalis silt loam too small to show on the map and some Wapato fine sandy loam areas lie near the streams.

The Wapato silt loam occurs in the southeastern and eastern parts of the county. The principal area occupies the flood plain of the Tualatin River, and small narrow bodies lie along some of the small streams tributary to it. It has a level, smooth surface broken only by shallow sloughs, the remnants of former channels of the streams. Most of it has fair surface drainage, but subdrainage is generally retarded by the subsoil. It is subject to annual overflow during the winter months, and backwater from the larger streams covers some of it for long periods.

Most of the type is cleared and farmed. It is considered a very fertile soil, but it often dries out late in the spring so that crops can not be put in early and they may suffer in dry seasons because of this lateness. It is small in extent but its desirable qualities make it relatively important. It is used mainly for growing oats, corn, clover, vetch, and garden vegetables. All these crops give very satisfactory returns when conditions are favorable. Much of this type occurs in such small strips that it is included in farms with other types, and no separate system of farm management has been worked out for it.

Tile drainage should be supplied in areas that are poorly drained. Care should be taken to keep up the humus supply in the soil, as continual cropping will decrease it. Application of lime should be made to correct the acidity.

### WAPATO SILTY CLAY LOAM.

The surface soil of the Wapato silty clay loam has an average depth of 12 inches. It is generally dark grayish brown but may vary to brown or dark brownish gray, and in places is mottled. In texture it is typically a silty clay loam, varying from light to very heavy and including locally some silty clay. Where drained and aerated it has a granular structure and, considering its heavy texture, is not difficult to cultivate. It retains moisture well. It contains a large proportion of organic matter and is mildly acid. The subsoil is a silty clay loam or silty clay of dark-gray or drab color, mottled with gray, yellow and brown iron stains. It is somewhat compact, but is fairly permeable to water and plant roots. As mapped in this area, the Wapato silty clay loam contains areas of the Wapato silt loam, Wapato silty clay, Chehalis silt loam, Muck and Peat, and the Cove

clay too small to show on the map. The Cove clay is a type not mapped in this county, but found in other parts of the State. It is black sticky clay underlain by a heavy gray or drab mottled subsoil.

Small fragments of bog-iron ore brought up by the plow were observed, and iron-cemented hardpan about a foot below the surface was also encountered. But these traces of hardpan and bog iron are found in small areas and are of relatively little importance.

The Wapato silty clay loam is well scattered over the valley part of the county, being found as narrow strips on the flood plains of many of the streams. It is especially abundant along Dairy, Beaverton, Rock, and McKay Creeks and the Tualatin River. It has the typical first bottom topography. Surface drainage is rather deficient and subdrainage is poor. It is subject to annual overflow.

This is one of the least extensive types in the area, but it is prized as a valuable soil. Probably about half of it has been cleared and put under cultivation. The part still uncleared is covered with a mixed growth of trees and brush, usually of the water-loving species, with grasses and sedges. The cost of drainage and the occurrence of the type in such narrow strips are hindrances to its development. When properly drained this soil is suited to the production of oats, corn, clover, potatoes, and truck crops. It is one of the main truck soils of the area, but its productiveness is lessened by the fact that it dries out slowly in the spring, which delays planting and subjects the crops to damage from drought in dry years.

Recommendations for improvement include drainage where needed, maintaining the supply of organic matter by the use of stable manure and green manures, and the application of lime to correct acidity.

### WHITESON SILT LOAM.

The Whiteson silt loam consists of 10 to 12 inches of a brownish-gray or light-gray to gray, smooth silt loam, underlain by a subsoil of somewhat heavier texture, compact structure, and gray or drab color, mottled with brown or yellow. At a depth of 24 to 36 inches there is usually encountered a layer of stiff, impervious drab to gray clay, from 2 to 5 inches thick. Below this is a more yellowish and coarser textured material, mottled with drab and brown. The surface soil is low in organic matter and has a tendency to be sticky when wet and to bake and become difficult to cultivate. This is one of the least extensive types in the county. One small body is located a mile east of Cipole, another in the vicinity of Cherry Grove, and two small areas occur in the neighborhood of Lousignont Lake. The type occupies level and smooth bottom land with poor drainage. It is subject to overflow each winter. About one-third of it is under cultivation, the remainder being in pasture. The principal crops are oats and vetch, of which the yields are only moderate.

This soil is in need of tile drainage. After being drained, deeper plowing and the turning under of green manure crops would be beneficial. Liming would help the growth of legumes.

### MUCK AND PEAT.

The material mapped as Muck and Peat consists of partly decomposed organic matter originating in the decay of water-loving plants, with an admixture of relatively small and variable proportions of fine mineral material. Muck and Peat are in many places mapped as separate types, but in this county they are so intimately associated that it is impractical to separate them on the map. Peat is a dark-brown or nearly black, spongy, fibrous material that has undergone considerable decay, but has not yet lost its fibrous structure. As occurring in this survey it is usually underlain by Muck at a depth of 12 to 20 inches. Muck is black and well decomposed, of smooth structure, and has lost nearly all evidence of vegetable origin.

As mapped in this area nearly all the bodies of Muck and Peat contain an admixture of considerable mineral soil material, which occurs in places as an overwash from a few inches to a foot thick, or as strata or lenses at any depth below the surface. Where Peat has an overwash of soil material, it is likely to appear light gray when dry and bleached by the sun.

Many of the beds that have been farmed for a long time have undergone considerable modification owing to the fact that cultivation hastens decay and lowers the surface level.

Flood waters from the adjoining higher lands are continually bringing mineral sediments to these areas. All these agencies tend to lower the percentage of organic matter and increase the percentage of mineral matter, and some of the areas originally Muck and Peat are now included with other soils.

The depth of the organic deposits giving Muck and Peat varies from 1 or 2 feet to 10 to 20 feet.

Peat has a good moisture-holding capacity, but very poor capillarity; consequently crops suffer from drought if the water table is as much as 30 inches below the surface. It has a loose spongy structure and is very easy to cultivate. Muck is somewhat less subject to drought.

Areas of Muck and Peat are well distributed over the lowlands of the county. They occupy poorly drained depressions; in a number of cases ox-bow lakes or bayous representing former stream channels of the Tualatin River.

Most of the areas are small. A fair-sized area located 2 miles southwest of Banks appears to have been formed by the damming of a stream by the fine material brought down by the West Fork

of Dairy Creek. The Muck and Peat in Lake Wapato and Lousignont Lake was formed by the growth and decomposition of vegetation in these shallow lakes. The area west of Cipole occurs in a depression, which appears to have been caused by a radical change in the course of Tualatin River. The popular name for Muck and Peat in this region is "Beaverdam soil," and it is a general belief that the deposits were formed by the beavers damming up the streams, which may have been the case in a few instances.

In their native state the areas of Muck and Peat occur as bogs covered with a tangled growth of water-loving trees, vines, grasses, and sedges. The surface is very uneven owing to the partly fallen timber embedded within the peat or lying upon the surface, and to the tufts of grass and sedge. Drainage is poor and water stands over the surface or within a few inches of the surface.

In bringing this material under cultivation the surface growth is cleared off and open ditches constructed. Later the area is thoroughly drained with tile, the drains being about 3 feet deep and from 50 to 100 feet apart. Much of the Muck and Peat is subject to overflow during the winter season, owing to its low-lying position. About two-thirds of the area of this material has been reclaimed and is now the most highly valued soil in the county. It is held at $500 to $1,000 an acre. It is used mostly for growing onions and other truck crops. The yields of these crops are large. Barnyard manure and superphosphate have been found to give good returns, and their use is advised where yields have begun to decline.

### ROUGH MOUNTAINOUS LAND.

Rough mountainous land as mapped in this county includes hilly, steep, and rough areas which, because they are sparsely settled, predominantly nonagricultural in character, and largely inaccessible, were not mapped in detail or classified with regard to the individual soil series and types represented. However, all the roads and the conditions of settlement are indicated upon the soil map, and the soil conditions were noted as far as practicable. Much of the country is relatively inaccessible, on account of rough topography, dense forest cover, and entire lack of roads or trails, and this limited practical soil work. Owing to difficulty of accurate traverse and to the probability that it will be many years before the country is farmed to any extent, it was not considered advisable to incur the expense of mapping the region in detail, and a general description of soil conditions was deemed sufficient at this time.

The soil types occurring in the Rough mountainous land are mainly the Melbourne loam and the Olympic loam and clay loam. There are included with the areas of these main types smaller bodies of the Aiken silty clay loam and clay loam, and narrow strips of

the Chehalis and Wapato soils on the bottoms of the streams, with small bodies of soils of the Willamette series, and probably others. A small body of Sites clay is mapped in Yamhill County, adjoining the Rough mountainous land in this county, and it is probable that some of this material extends into Washington County. There are practically no rock exposures or areas of stony land.

Rough mountainous land occupies the rougher and more hilly parts of the low ranges associated with the Coast Range Mountains. The elevation varies from a few hundred feet to a maximum of 2,600 feet, with most of the area between 1,000 and 2,000 feet. The topography is erosional and is characterized by rolling hills at the lower elevations, grading in ruggedness through higher and steeper hills to steep and broken hillsides. These hills are interspersed with narrow stream valleys, most of them rather young and practically without flood plains, but the larger valleys have well-defined bottoms occupied by strips of recent-alluvial soil. There are a few terraces of small extent occupied by old valley filling soils. The west and the north slopes are in the main more steep and rugged than the slopes toward the main valley of the county. The rocks have been weathered very deeply over the whole Coast Range, and bedrock is encountered near the surface in only a few places where erosion has been especially severe. The soil is correspondingly deep, generally 5 feet. The limiting factor with regard to agriculture is the topography. Many of the flat-topped ridges and more gentle slopes, comprising perhaps 25 per cent of the surface, are readily cultivable. Probably an area of equal extent, although steep, could be tilled with difficulty. Approximately half of the area is too steep for profitable cultivation and should be kept in forest or pasture.

The agricultural possibilities of the soils represented in this classification are similar to those of the same soils mapped in the developed parts of the county, modified by topography and by slight variations in climate due to differences in elevation and to proximity to the ocean.

Some fruit is grown in small home orchards. Grain hay yields from 1 to 2 tons per acre.

The Rough mountainous land of this county was originally covered with a dense growth of heavy timber, mostly Douglas fir, with a mixture of cedar and white fir. Over the hills there is an undergrowth of various shrubs and ferns. Along the stream bottoms there is a large proportion of poplar, maple, ash, willow, and similar trees. Lumber companies have erected numerous sawmills and have logged over a considerable part of the county, and forest fires have destroyed considerable timber, but there are still large tracts of valuable forests left. But whether the original forest still stands or the ground has been logged over, there still remain the stumps to be

taken out before farming operations can be carried on. Owing to the great number and size of the stumps this is very costly. It is reported that it costs from $100 to $200 an acre to get the stumps out. Under present economic conditions the clearing costs more than the land is worth after it is cleared.

Settlement in these areas is very sparse. Much of the land is now held by lumber companies that are making no effort to develop the county agriculturally. Many of the original homesteaders have disappeared. Only a few are left, and they make a living by ranging a few cattle in the forest, growing grain and feed for the stock, and occasionally disposing of some fruit or potatoes. The owners of land in the remote parts report that their land has no market value other than the value of the standing timber. As the soil is deep and much of the land has a high potential agricultural value, the country will ultimately be developed. But the high cost of clearing will defer the development for many years.

## SUMMARY.

The Washington County area lies in the northwestern part of Oregon, just west of Portland, and constitutes a part of the Willamette Valley.

About one-fourth of the county consists of comparatively level valley from 140 to 275 feet above sea level. The rest of the county consists of hills or low mountains ranging from 800 to 2,000 feet in elevation with a few peaks which reach to about 2,500 feet in elevation. The valley floor and the lower and more gentle slopes can be cultivated, but owing to steep and unfavorable topography not more than half of the higher slopes are capable of successful cultivation.

The original forest still covers a large part of the hills, but the valley floor is mostly cleared. The Tualatin River drains most of the county. It flows southeast and enters the Willamette River soon after it passes out of the county.

Settlement began in 1834, and in the forties there was a large influx of settlers. The population is predominantly American born. Hillsboro and Forest Grove are the main towns. There is a fair density of rural population in the valley, but in the hills settlement is scattering.

The county is well supplied with railroads and wagon roads. Portland is the principal outside market for surplus agricultural products. The county has a mild, humid climate. At Forest Grove, which is representative of the valley part, the average annual temperature is 51.1° F. and the average annual rainfall is 48.74 inches.

Washington has always been an agricultural county. The raising of live stock was the first industry. After 1850 the acreage of field crops gradually increased. Wheat and oats were the main crops. Since 1900 wheat has been relatively less important. Hops have been an important crop, but now only a few hop yards are left.

Grain growing, dairying, and fruit growing are the predominating agricultural interests. Onion growing on the Peat and Muck, though occupying a comparatively small acreage, is important because of the high return per acre. The growing of orchard fruits is confined mostly to the hills soils. The dairy industry is confined to the valley lands. The most common rotation is a three-year or four-year rotation of small grain, clover for either one or two years, and a cultivated crop. Most of the farms are operated by the owners.

The soils of the area fall mainly into the groups of residual soils, old valley-filling soils, and recent-alluvial soils.

The residual soils of the area include those of the Aiken, Olympic, Cascade, Melbourne, and Carlton series.

The old valley-filling soils are represented by the Willamette, Hillsboro, Amity, and Dayton series.

The recent-alluvial soils comprise those of the Chehalis, Camas, Wapato, and Whiteson series.

In addition miscellaneous materials were mapped, including Muck and Peat, derived from the accumulation and decay of aquatic plants; and Rough mountainous land, which includes materials of a number of soil series and types, but is nonagricultural in part owing to adverse topography.

All the soils of the county are well leached of soluble minerals and are noncalcareous, and many of them are in places distinctly acid.

The Aiken silty clay loam and clay loam are both minor types. They are found in the hills and are well adapted to fruit, where conditions of topography are favorable.

The Olympic loam and clay loam are well distributed over the area and constitute some of the main residual soils. They are good fruit and general farming soils.

The Cascade silt loam is a moderately extensive type of soil still largely uncleared, but developed and utilized to some extent for general farm and fruit crops.

The Melbourne loam is an extensive type and well distributed over the county. All the common farm crops are grown, giving medium to very good yields. A wide variety of fruits can be grown successfully.

The Melbourne clay is a minor type. General farm crops and fruit give medium to high yields.

The Carlton silt loam and the Carlton silty clay loam occur in small bodies well scattered over the county. They are used mostly as pasture land for the production of small grain. Yields are moderate to low.

The Willamette loam is an extensive and important type, occurring in the main valley part of the county, practically all of it under cultivation. Dairying is the main type of farming.

The Hillsboro loam occurs in an area of several square miles between Forest Grove and Hillsboro. It is a valuable soil. General farm crops and truck are grown, and yields are high.

The Amity silt loam is a minor type, not quite so valuable as the Willamette loam.

The Dayton silt loam occurs only in small bodies and is considered one of the least desirable types in the county.

The Chehalis loam is of very small extent but is a valuable and productive soil.

The Chehalis silt loam is well distributed over the flood plains of the larger streams. It is a very valuable soil and is suited to general farm crops.

The Chehalis clay loam is a minor type. It is well suited to grain and general farm crops.

The Camas loam is a type of small extent and of variable value, according to the depth at which the gravel subsoil is encountered.

The Wapato silt loam and silty clay loam are of moderate extent. They are not quite as valuable as the Chehalis soils.

The Whiteson silt loam is one of the least extensive types. The principal crop is grain and yields are only moderate.

Muck and Peat are classed together. The areas are very small, but where reclaimed and tiled are very valuable for onions and other truck crops.

Rough mountainous land is very extensive, and includes much of the western part of the county.

○

# Accessibility Statement

This document is not accessible by screen-reader software. The U.S. Department of Agriculture is committed to making its electronic and information technologies accessible to individuals with disabilities by meeting or exceeding the requirements of Section 508 of the Rehabilitation Act (29 U.S.C. 794d), as amended in 1998. Section 508 is a federal law that requires agencies to provide individuals with disabilities equal access to electronic information and data comparable to those who do not have disabilities, unless an undue burden would be imposed on the agency. The Section 508 standards are the technical requirements and criteria that are used to measure conformance within this law. More information on Section 508 and the technical standards can be found at www.section508.gov.

If you require assistance or wish to report an issue related to the accessibility of any content on this website, please email Section508@oc.usda.gov. If applicable, please include the web address or URL and the specific problems you have encountered. You may also contact a representative from the USDA Section 508 Coordination Team.

**Nondiscrimination Statement**

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the

Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at http://www.ascr.usda.gov/complaint_filing_cust.html and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by:

(1) mail: U.S. Department of Agriculture
Office of the Assistant Secretary for Civil Rights
1400 Independence Avenue, SW
Washington, D.C. 20250-9410;

(2) fax: (202) 690-7442; or

(3) email: program.intake@usda.gov.

USDA is an equal opportunity provider, employer, and lender.

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF
CURTIS F. MARBUT, IN CHARGE SOIL SURVEY

# SOIL MAP
## OREGON
## WASHINGTON COUNTY SHEET

OREGON AGRICULTURAL EXPERIMENT STATION
A. B. CORDLEY, DIRECTOR.
W. L. POWERS, IN CHARGE SOIL SURVEY.

## LEGEND

| | |
|---|---|
| Aiken clay loam (A) | Dayton silt loam (Dl) |
| Aiken silty clay loam (Al) | Hillsboro loam (H) |
| Amity silt loam (Am) | Melbourne loam (M) |
| Camas loam (C) | Melbourne clay (Mc) |
| Carlton silt loam (Cl) | Olympic loam (Om) |
| Carlton silty clay loam (Cs) | Olympic clay loam (Ol) |
| Cascade silt loam (Ca) | Wapato silt loam (Wa) |
| Chehalis loam (Cm) | Wapato silty clay loam (Wc) |
| Chehalis silt loam (Ce) | Whiteson silt loam (W) |
| Chehalis clay loam (Cc) | Willamette loam (Wl) |
| Muck and Peat (Mp) | Rough mountainous land (R) |

## CONVENTIONAL SIGNS

CULTURE (Printed in black.)

- City or Village, Roads, Buildings, Wharves, Jetties, Breakwater, Levee, Lighthouse, Fort.
- Secondary roads and Trails
- Railroads Steam and Electric
- Bridges, Ferry
- R.R. crossings, Tunnel
- Ford, Dam
- Schools, Church, Cemeteries
- Mine or Quarry, Mine dumps, Made land
- Bluff, Escarpment, Rock outcrop, and Triangulation station
- Stony and Gravelly areas
- Soil boundaries
- Boundary lines (State, County)
- Boundary lines (Land Grant, City or Village)
- Boundary lines (Civil Township, Reservation)
- U.S. township and section lines

RELIEF (Printed in brown or black)

- Contours, Depression contours
- Prominent Hills, Mountain Peaks
- Sand, Wash, and Sand dunes
- Shore and Low-water line, Sandbar

DRAINAGE (Printed in blue)

- Streams
- Lakes, Ponds, Intermittent lakes
- Intermittent streams
- Springs, Canals and Ditches, Flumes
- Swamp, Salt marshes
- Submerged marsh, Tidal flats

*The above signs are as current use on the maps. Variations from this usage appear in some maps of earlier issue.*

Macy H. Lapham, Inspector, Western Division.
Soils surveyed by E. B. Watson, in charge, and L. T. Edmann of the U. S. Department of Agriculture and A. L. Fluharty and S. C. Jones of the Oregon Agricultural Experiment Station.

BASE MAP IN PART FROM U. S. GEOLOGICAL SURVEY SHEETS

Scale 1 inch = 1 mile
1 0 1 2 3 4 Miles

WILLIAMS-WEBB CO., WASH., D.C.

Field Operations
Bureau of Soils
1918